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*Nelumbo nucifera* Gaertn. - National Flower of India with population of *Nymphaea* in the background

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## ADDITIONS TO MELIOLALES OF INDIA

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### ABSTRACT

This paper gives an account of seven new meliolaceous fungi collected from Kerala State belonging to three genera, namely, *Amazonia dikesinghii*, *Asteridiella amomi*, *Meliola aganopes*, *M. cayratiae*, *M. cipadessae*, *M. mesuae* and *M. sanjappae*. They have been described and illustrated in detail.

**Keywords :** New, Black mildews, *Amazonia*, *Asteridiella*, *Meliola*, Kerala, India.

### INTRODUCTION

During a survey of the foliicolous fungi, authors have made several collections in the Western Ghats region of Kerala State. Of these, the following seven new species collected from Peppara and Neyyar Wildlife Sanctuaries in Thiruvananthapuram and Vazhachal forest range of Thrissur districts, respectively, have been presented here.

### TAXONOMY

#### 1. *Amazonia dikesinghii* Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 1).

*Typus:* On leaves of *Pogostemon travancoricus* Bedd. (Lamiaceae), Athirumala, Peppara Wildlife Sanctuary, Thiruvananthapuram, Kerala March 2, 2008, *Jacob Thomas* HClO 49045 (holotype), TBGT 3311 (isotype).

Coloniae epiphyllae, densae, ad 3 mm diam., dispersae. Hyphae subrectae vel flexuosae, alternate vel raro opposite acuteque ramosae, fortiter reticulatae et teges mycelialis solidus, cellulae 6-13 × 6-8 µm. Appressoria alternata vel unilateralis, recta vel curvula, antrorsa vel arte antrorsa et saepe hyphis appressus, 12-17 µm longa; cellulae basillares cylindratae vel cuneatae, 3-5 µm longae; cellulae ovatae vel globosae, integrae, 12-16 × 11-16 µm. Phialides producentes in hyphis separatis, alternatae vel oppositae, conoideae vel ampulliformes, 8-11 × 6-8 µm. Perithecia depresso-globosa, ad 200 µm diam.; ascospores oblongae vel ellipsoideae, 4-septatae, constrictae ad septatae, 35-40 × 12-18 µm.

Colonies epiphyllous, dense, up to 3 mm in diameter, scattered. Hyphae substraight to flexuous, branching alternate to rarely opposite at acute angles, very closely reticulate to form a solid mycelial mat, cells 6-13 × 6-8 µm. Appressoria alternate to unilateral, straight to curved, antrorse to closely antrorse and often appressed to the hyphae, 12-17 µm long; stalk cells cylindrical to cuneate, 3-5 µm long; head cells ovate to globose, entire, 12-16 × 11-16 µm. Phialides born on a separate mycelial branches, alternate to opposite, conoid to ampulliform, 8-11 × 6-8 µm. Perithecia flattened-globose, up to 200 µm in diameter; ascospores oblong to ellipsoidal, 4-septate, constricted at the septa, 35-40 × 12-18 µm.

There are no other species of the genus *Amazonia* on the members of Lamiaceae (Hansford, 1961; Hu & al., 1996, 1999; Hosagoudar, 1996, 2008; Hosagoudar & al., 1997; Hosagoudar & Agarwal, 2008).

This species is named in honour of Dr. D. K. Singh, Botanical Survey of India for his contributions to Botany.

#### 2. *Asteridiella amomi* Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 2).

*Typus:* Kombe, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, March 4, 2008, *Jacob Thomas* & al. HClO 48834 (holotype), TBGT 3210 (isotype).

Coloniae amphigenae, densae, subvelutinae, ad 4 mm diam., confluentes. Hyphae subrectae vel leniter anfractuae, opposite vel irregulariter acuteque vel laxae ramosae, laxae reticulatae, cellulae 19-36 × 7-10 µm.

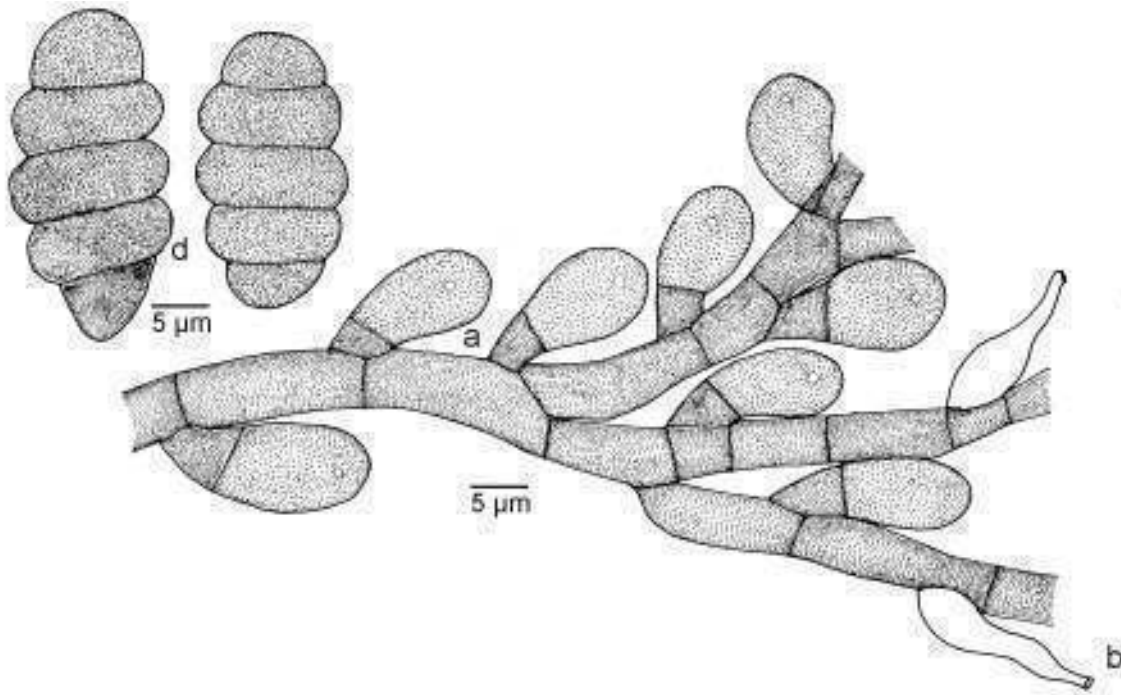


Fig. 1. *Amazonia dikesinghii* : a. Appressorium; b. Phialide; d. Ascospores.

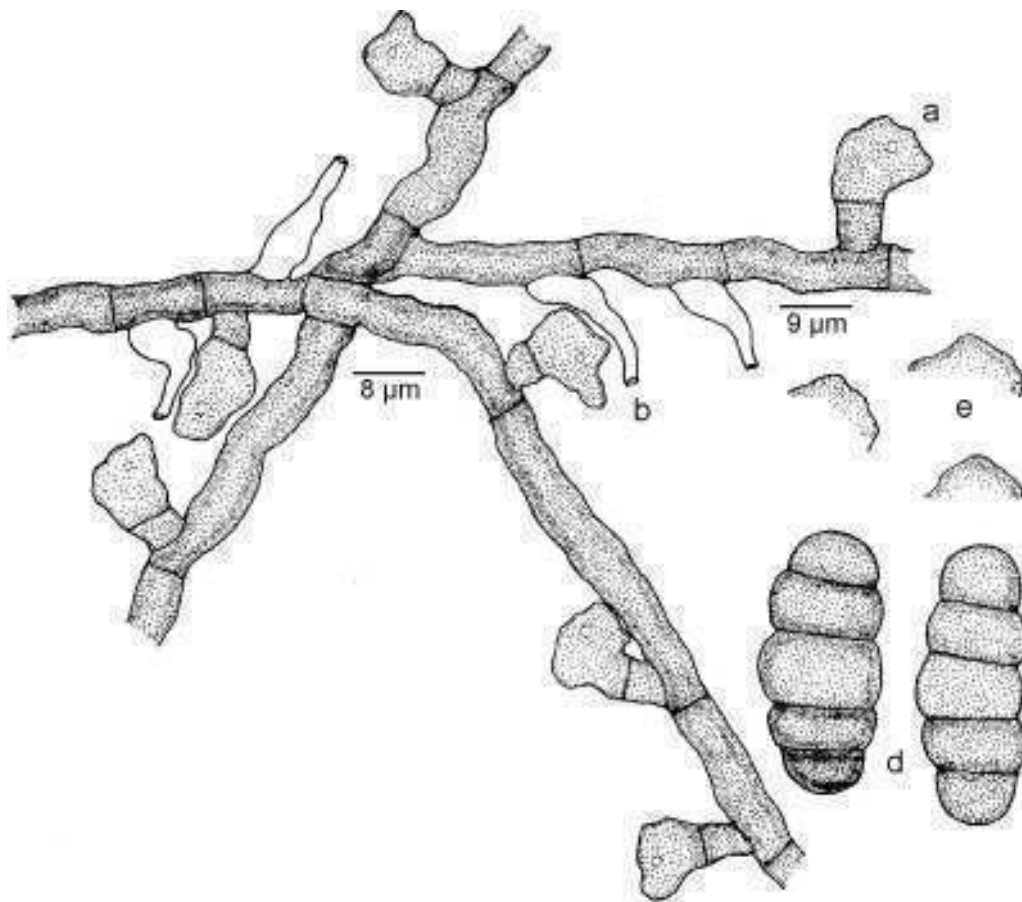


Fig. 2. *Asteridiella amomi* : a. Appressorium; b. Phialide; d. Ascospores; e. Perithecial wall cells.

Appressoria alternata et unilateralis, recta vel curvula, antrorsa vel patentia, 21-29  $\mu\text{m}$  longa; cellulae basiliares cylindratae vel cuneatae, 9-12  $\mu\text{m}$  longae; cellulae apicales ovatae, globosae, angularis vel sublobatae, 12-18  $\times$  9-15  $\mu\text{m}$ . Phialides appressoriis mixtus, alternatae vel oppositae, ampulliformes, 19-26  $\times$  4-7  $\mu\text{m}$ . Perithecia dispersa, ad 100  $\mu\text{m}$  diam.; cellulae peritheciales conoideae vel mammiformes, 9-14  $\times$  9-12  $\mu\text{m}$  longae; ascospores ellipsoideae, 4-septatae, constrictus ad septatae, 36-41  $\times$  14-17  $\mu\text{m}$ .

Colonies amphigenous, dense, subvelvety, up to 4 mm in diameter, confluent. Hyphae substraight to slightly crooked, branching opposite to irregular at acute to wide angles, loosely reticulate, cells 19-36  $\times$  7-10  $\mu\text{m}$ . Appressoria alternate and unilateral, straight to curved, antrorse to spreading, 21-29  $\mu\text{m}$  long; stalk cells cylindrical to cuneate, 9-12  $\mu\text{m}$  long; head cells ovate, globose, angular to sublobate, 12-18  $\times$  9-15  $\mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform, 19-26  $\times$  4-7  $\mu\text{m}$ . Perithecia scattered, up to 100  $\mu\text{m}$  in diameter; perithecial cells conoid to mammiform, 9-14  $\times$  9-12  $\mu\text{m}$  long; ascospores ellipsoidal, 4-septate, constricted at the septa, 36-41  $\times$  14-17  $\mu\text{m}$ .

*Other materials examined:* On leaves of *Amomum subulatum* Roxb. (Zingiberaceae), Athirumala, Peppara Wildlife Sanctuary, Thiruvananthapuram, Kerala, March 4, 2008, *Jacob Thomas* & al. HCIO, TBGT 3209. Two species of the genus *Asteridiella*, namely, *A. costi* (Stev.) Hansf. and *A. parasitica* (Stev.) Hansf. are known on *Costus* sp. from Panama and Ecuador, respectively. However, *Asteridiella amomi* differs from both the species in having broader mycelial cells, longer appressoria with entire to lobate head cells. Further, this forms the first record of meliolaceous fungus on the genus *Amomum* (Hansford, 1961).

### 3. *Meliola aganopes* Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 3).

*Typus:* On leaves of *Aganope thyrsiflora* (Benth.) Polh. (Fabaceae), Vazhachal, Thrissur, Kerala, Aug. 21, 2007, *Jacob Thomas* & al. HCIO 49016 (holotype), TBGT 3271 (isotype).

Coloniae epiphyllae, subdensae, crustosae, ad 4 mm diam., confluentes. Hyphae rectae, oppositae acuteque vel subacuteque ramosae, laxae reticulatae, cellulae 24-46  $\times$  4-7  $\mu\text{m}$ . Appressoria alternata, ad 1% opposita, antrorsa vel patentia, recta vel curvula, 14-19  $\mu\text{m}$  longa; cellulae basiliares cylindratae vel cuneatae, 2-5  $\mu\text{m}$  longae; cellulae apicales ovatae vel oblongae, integrae, rotundatae ad apicem, 9-15  $\times$  7-10  $\mu\text{m}$ . Phialides appressoriis mixtus, alternatae vel oppositae, ampulliformes, 14-22  $\times$  6-8  $\mu\text{m}$ . Setae myceliales numerosae, dispersae, rectae, simplices, acutae vel dentatae ad apicem, ad 740  $\mu\text{m}$  longae. Perithecia dispersa, verrucosa, ad 170  $\mu\text{m}$  diam.; ascospores cylindratae vel oblongae, 4-septatae, constrictus ad septatae, 33-38  $\times$  12-15  $\mu\text{m}$ .

Colonies epiphyllous, subdense, crustose, up to 4 mm in diameter, confluent. Hyphae straight, branching opposite at acute to subacute angles, loosely reticulate, cells 24-46  $\times$  4-7  $\mu\text{m}$ . Appressoria alternate, about 1% opposite, antrorse to spreading, straight to curved, 14-19  $\mu\text{m}$  long; stalk cells cylindrical to cuneate, 2-5  $\mu\text{m}$  long; head cells ovate to oblong, entire, rounded at the apex, 9-15  $\times$  7-10  $\mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform, 14-22  $\times$  6-8  $\mu\text{m}$ . Mycelial setae fairly numerous, scattered, straight, simple, acute to dentate at the tip, up to 740  $\mu\text{m}$  long. Perithecia scattered, verrucose, up to 170  $\mu\text{m}$  in diam.; ascospores cylindrical to oblong, 4-septate, constricted at the septa, 33-38  $\times$  12-15  $\mu\text{m}$ .

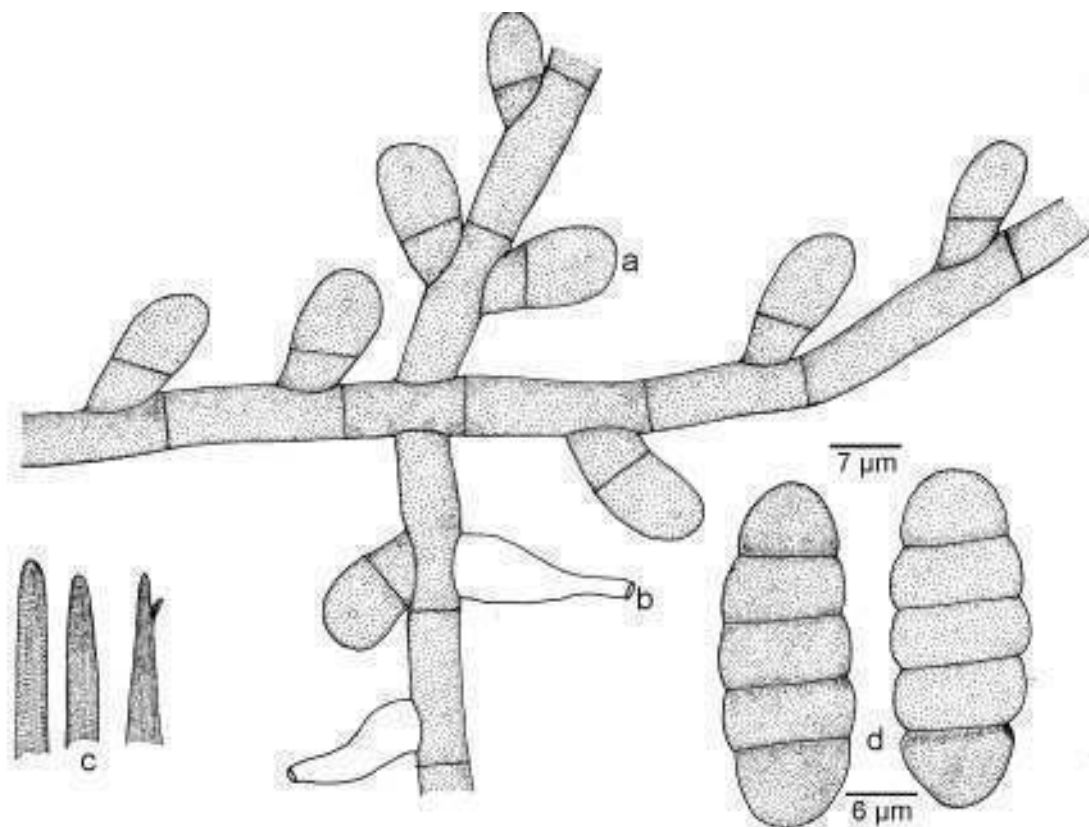
Based on the digital formula 31<sup>1</sup>/<sub>3</sub>.3223, *Meliola aganopes* is similar to *M. teramni* var. *milletiae* Hosag. reported on *Milletia rubiginosa* from the Western Ghats region of Tamil Nadu (Hosagoudar & Goos, 1991; Hosagoudar, 1996). However, *Meliola aganopes* differs from it in having typically ovate to oblong head cells of appressoria with appreciable number of mycelial setae.

### 4. *Meliola cayratiae* Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 4).

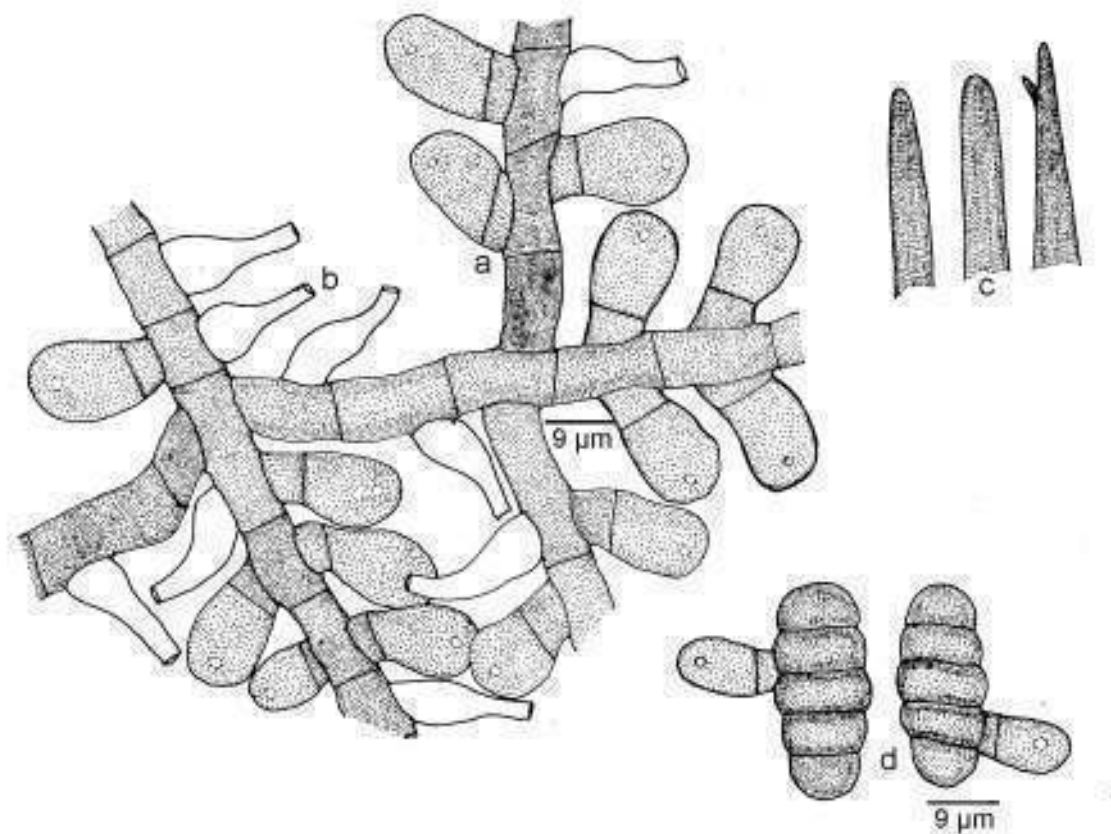
*Typus:* On leaves of *Cayratia pedata* (Lam.) A.L.Juss. ex Gagnepain (Vitaceae), Pongalappara, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, March 1, 2008, *Jacob Thomas* HCIO 48840 (holotype), TBGT 3216 (isotype), TBGT 3217.

Coloniae epiphyllae, densae, velutinae, dispersae, ad 2 mm diam.. Hyphae rectae vel undulatae, oppositae acuteque vel laxae ramosae, arte reticulatae et formans rete mycelialis, cellulae 12-22  $\times$  7-12  $\mu\text{m}$ . Appressoria opposita, ad 20% alternata vel unilateralis, dense positus, plerumque antrorsa, raro patentia, recta vel leniter curvula, 16-22  $\mu\text{m}$  longa; cellulae basiliares cylindratae vel cuneatae, 2-5  $\mu\text{m}$  longae; cellulae apicales ovatae vel oblongae, cylindratae, integrae, leniter angularis, saepe truncatae ad apicem, 14-19  $\times$  9-15  $\mu\text{m}$ . Phialides





**Fig. 3.** *Meliola aganopes* : a. Appressorium; b. Phialide; c. Apical portion of the mycelial setae; d. Ascospores.



**Fig. 4.** *Meliola cayratiae* : a. Appressorium; b. Phialide; c. Apical portion of the mycelial setae; d. Ascospores.



appressoriis mixtus, alternatae to oppositae, ampulliformes,  $16-22 \times 7-10 \mu\text{m}$ . Setae myceliales circa perithecia aggregatae, rectae, simplices, obtusae vel late rotundatae ad apicem, ad  $520 \mu\text{m}$  longae. Perithecia dispersa, verrucosa, ad  $240 \mu\text{m}$  diam.; ascospores cylindriceae vel subellipsoideae, 4-septatae, constrictus ad septatae,  $38-43 \times 14-17 \mu\text{m}$ .

Colonies epiphyllous, dense, velvety, scattered, up to 2 mm in diameter. Hyphae straight to undulate, branching opposite at acute to wide angles, closely reticulate to form a mycelial mat, cells  $12-22 \times 7-12 \mu\text{m}$ . Appressoria opposite, about 20% alternate to unilateral, very closely placed, mostly antrorse, rarely spreading, straight to slightly curved,  $16-22 \mu\text{m}$  long; stalk cells cylindrical to cuneate,  $2-5 \mu\text{m}$  long; head cells ovate to oblong, cylindrical, entire, slightly angular, often truncate at the apex,  $14-19 \times 9-15 \mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform,  $16-22 \times 7-10 \mu\text{m}$ . Mycelial setae grouped around perithecia, straight, simple, obtuse to broadly rounded at the tip, up to  $520 \mu\text{m}$  long. Perithecia scattered, verrucose, up to  $240 \mu\text{m}$  in diam.; ascospores cylindrical to subellipsoidal, 4-septate, constricted at the septa,  $38-43 \times 14-17 \mu\text{m}$ .

Based on the digital formula 3113.4233, it is similar to *Meliola bakeri* Sydow (Hansford, 1961; Hosagoudar, 1997; Hosagoudar & Agarwal, 2008) but differs from it in having mycelial setae grouped around perithecia with broadly obtuse tip. Often sterile mycelia emerged from the base of the perithecia.

**5. *Meliola cipadessae*** Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 5).

*Typus*: On leaves of *Cipadessa baccifera* (Roth) Miq. (Meliaceae), Bonoccord, Peppara Wildlife Sanctuary, Thiruvananthapuram, Kerala, March 6, 2008, *Jacob Thomas* HCIO 48871 (holotype), TBGT 3247 (isotype).

Coloniae epiphyllae, tenues, velutinae, dispersae, ad 2 mm diam., confluentes, mixtus colonies *Aserina cipadessae*. Hyphae rectae vel subrectae, opposite acuteque ramosae, arte reticulatae, cellulae  $16-26 \times 6-8 \mu\text{m}$ . Appressoria alternata, recta vel curvula, antrorsa vel patentia,  $16-21 \mu\text{m}$  longa; cellulae basilares cylindriceae vel cuneata,  $4-8 \mu\text{m}$  longa; cellulae apicales rectae vel curvulae, ovatae, globosae, cylindriceae, integrae,  $11-16 \times 6-10 \mu\text{m}$ . Phialides appressoriis mixtus, alternatae vel oppositae, ampulliformes,  $12-19 \times 6-8 \mu\text{m}$ . Setae myceliales dispersae vel juxta perithecia aggregatae, simplices, rectae, acutae vel obtusae ad apicem, ad  $550 \mu\text{m}$  longae. Perithecia aggregata, verrucosa, ad  $210 \mu\text{m}$  diam.; ascospores obovoideae vel cylindriceae, 4-septatae, constrictus ad septatae,  $32-35 \times 12-15 \mu\text{m}$ .

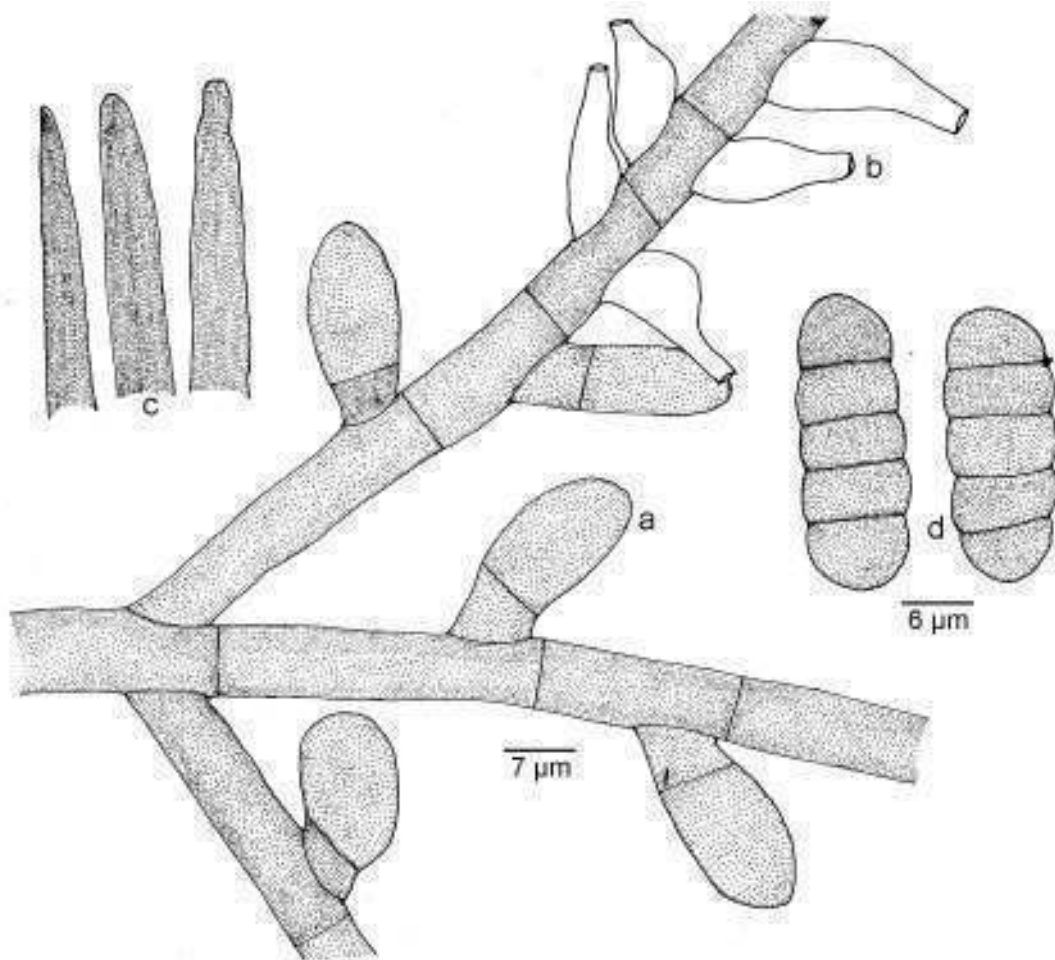
Colonies epiphyllous, thin, velvety, up to 2 mm in diameter, confluent, mixed with the colonies of *Aserina cipadessae*. Hyphae straight to substraight, branching opposite at acute angles, closely reticulate, cells  $16-26 \times 6-8 \mu\text{m}$ . Appressoria alternate, straight to curved, antrorse to spreading,  $16-21 \mu\text{m}$  long; stalk cells cylindrical to cuneate,  $4-8 \mu\text{m}$  long; head cells straight to curved, ovate, globose, cylindrical, entire,  $11-16 \times 6-10 \mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform,  $12-19 \times 6-8 \mu\text{m}$ . Mycelial setae scattered to grouped around perithecia, simple, straight, acute to obtuse at the tip, up to  $550 \mu\text{m}$  long. Perithecia grouped, verrucose, up to  $210 \mu\text{m}$  in diameter; ascospores obovoidal to cylindrical, 4-septate, constricted at the septa,  $32-35 \times 12-15 \mu\text{m}$ .

Based on the digital formula 3111.3233, it can be compared with *Meliola togoensis* Hughes var. *angulata* Hughes known on *Trichilia prieuriana* from Gold Coast. However, differs from it in having shorter appressoria with entire head cells. Further, this is the first report of the genus *Meliola* on this host genus *Cipadessa* (Hansford, 1961; Hosagoudar, 1997; Hosagoudar & Agarwal, 2008).

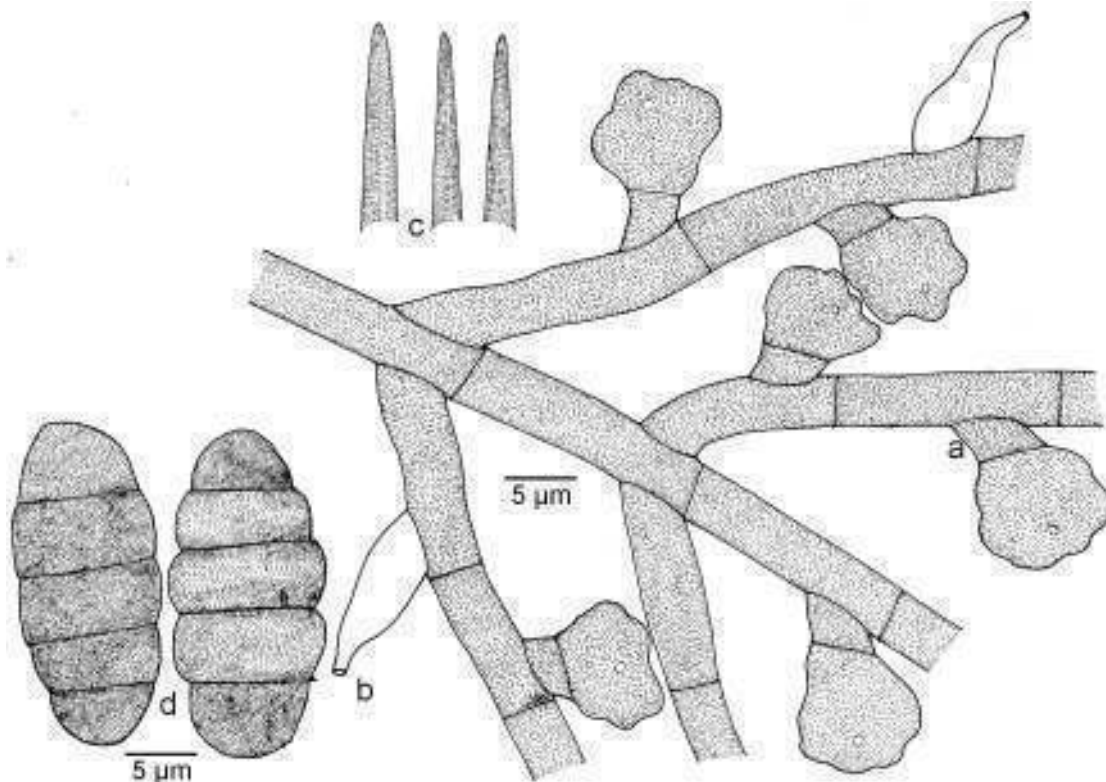
**6. *Meliola mesuae*** Hosag., J. Thomas & D.K. Agarwal **sp. nov.** (Fig. 6).

*Typus*: On leaves of *Mesua ferrea* L. (Clusiaceae), Kombe, Bonoccord, Peppara Wildlife Sanctuary, Thiruvananthapuram, Kerala, Feb. 28, 2008, *Jacob Thomas* HCIO 49074 (holotype), TBGT 3329 (isotype).

Coloniae amphigenae, plerumque epiphyllae, densae, ad 4 mm diam., raro confluentes. Hyphae straight, opposite acuteque vel laxae ramosae, laxae vel arte reticulatae, cellulae  $15-26 \times 6-9 \mu\text{m}$ . Appressoria alternata, ad 2% opposita, dense posita, antrorsa vel subantrorsa, recta vel curvula,  $17-29 \mu\text{m}$  longa; cellulae basilares cylindriceae vel cuneatae,  $4-13 \mu\text{m}$  longae; cellulae apicales ovatae vel globosae, integrae, raro angularis,  $11-20 \times 13-18 \mu\text{m}$ . Phialides appressoriis mixtus, alternatae vel oppositae, ampulliformes,  $13-26 \times 6-9 \mu\text{m}$ . Setae myceliales paucae, rectae, simplices, acutae ad apicem, ad  $280 \mu\text{m}$  longae. Perithecia dispersa, verrucosa, ad  $180 \mu\text{m}$  diam.; ascospores cylindriceae vel ellipsoideae, 4-septatae, leniter constrictus ad septatae,  $37-42 \times 17-20 \mu\text{m}$ .



**Fig. 5.** *Meliola cipadessae* : a. Appressorium; b. Phialide; c. Apical portion of the mycelial setae; d. Ascospores.



**Fig. 6.** *Meliola mesuae* : a. Appressorium; b. Phialide; c. Apical portion of the mycelial setae; d. Ascospores.

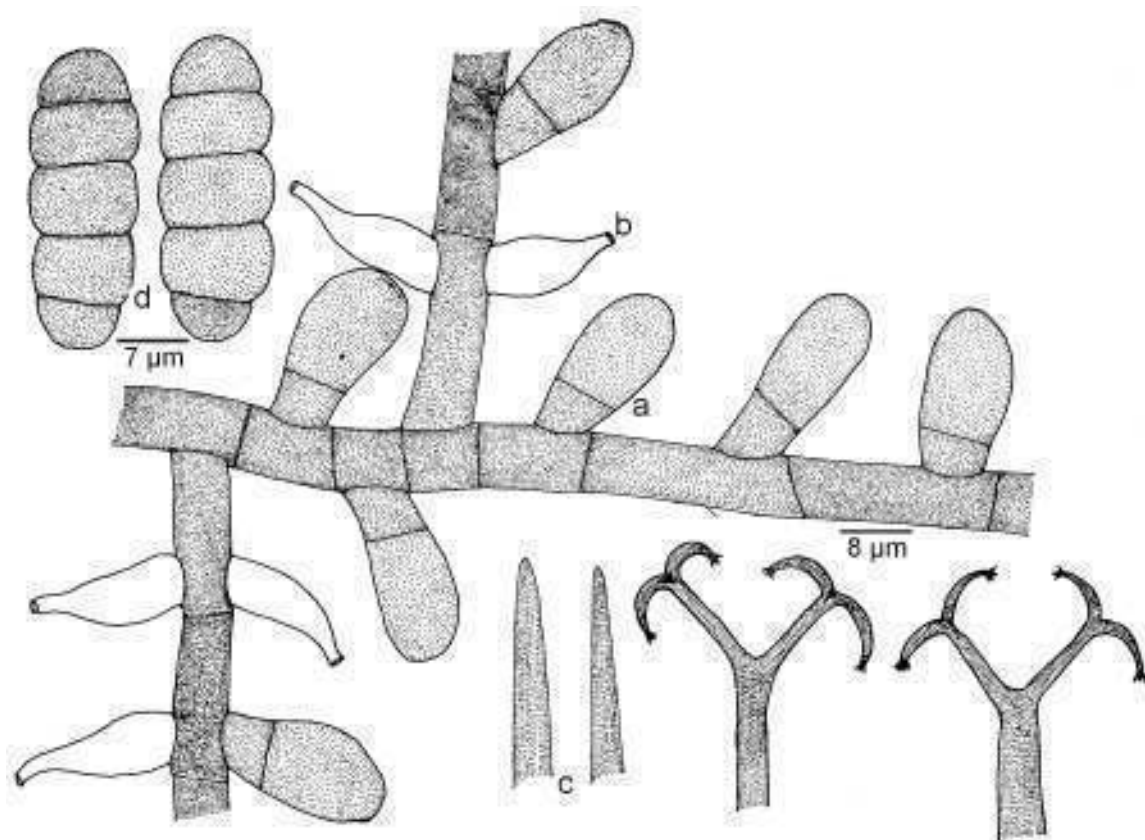
Colonies amphigenous, mostly epiphyllous, dense, up to 4 mm in diameter, rarely confluent. Hyphae straight, branching opposite at acute to wide angles, loosely to closely reticulate, cells  $15-26 \times 6-9 \mu\text{m}$ . Appressoria alternate, about 2% opposite, closely arranged, antrorse to subantrorse, straight to curved,  $17-29 \mu\text{m}$  long; stalk cells cylindrical to cuneate,  $4-13 \mu\text{m}$  long; head cells ovate to globose, entire, rarely angular,  $11-20 \times 13-18 \mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform,  $13-26 \times 6-9 \mu\text{m}$ . Mycelial setae few, straight, simple, acute at the tip, up to  $280 \mu\text{m}$  long. Perithecia scattered, verrucose, up to  $180 \mu\text{m}$  in diameter; ascospores cylindrical to ellipsoidal, 4-septate, slightly constricted at the septa,  $37-42 \times 17-20 \mu\text{m}$ .

Based on the angular head cells of the appressoria, this species can be compared with *Meliola clusiae* Stev. known on *Clusia* spp. from Porto Rico and Surinam but differs from it in having regularly antrorse appressoria, possessing few mycelial setae and having smaller ascospores (Hansford, 1961; Hosagoudar, 1996, 2008; Hosagoudar & al., 1997; Hosagoudar & Agarwal, 2008).

**7. *Meliola sanjappae* Hosag., J. Thomas & D.K. Agarwal sp. nov. (Fig. 7).**

*Typus*: On leaves of *Semecarpus travancorica* Bedd. (Anacardiaceae), Kombe, Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala, Mar. 5, 2008, *Jacob Thomas* HCIO 49043 (holotype), TBGT 3298 (isotype).

Coloniae epiphyllae, densae, velutinae, ad 4 mm diam., dispersa. Hyphae rectae, oppositae laxae ramosae, arte reticulatae et formans rete myceliales, cellulae  $17-35 \times 10-13 \mu\text{m}$ . Appressoria alternata, ad 5% opposita, antrorsa vel retrorsa, recta vel curvula,  $20-24 \mu\text{m}$  longa; cellulae basillares cylindratae vel cuneatae,  $4-10 \mu\text{m}$  longae; cellulae apicales cylindratae vel clavatae, curvulae, integrae, truncatae, angularis vel raro sublobatae,  $16-22 \times 9-16 \mu\text{m}$ . Phialides appressoriis mixtus, alternatae vel oppositae, ampulliformes,  $11-16 \times 8-11 \mu\text{m}$ . Setae myceliales dispersae, saepe numerosae, simplices, rectae, dichotomous ramosae, ramosum prima ad  $250 \mu\text{m}$  longae, primus radii ad  $70 \mu\text{m}$  longae, primus secundary ad  $5 \mu\text{m}$  longae, acutae vel dentatae ad apicem, ramorum reflexae. Perithecia dispersa, verrucosa, ad  $180 \mu\text{m}$  diam.; ascospores obovoideae vel subellipsoideae, 4-septatae, constrictus ad septatae,  $44-50 \times 20-23 \mu\text{m}$ .



**Fig. 7.** *Meliola sanjappae* : a. Appressorium; b. Phialide; c. Apical portion of the mycelial setae; d. Ascospores.

Colonies epiphyllous, dense, velvety, up to 4 mm in diameter, scattered. Hyphae straight, branching opposite at wide angles, closely reticulate and form a mycelial net, cells  $17-35 \times 10-13 \mu\text{m}$ . Appressoria alternate, up to 5% opposite, antrorse to retrorse, straight to curved,  $20-24 \mu\text{m}$  long; stalk cells cylindrical to cuneate,  $4-10 \mu\text{m}$  long; head cells cylindrical to clavate, curved, entire, truncate, angular to rarely sublobate,  $16-22 \times 9-16 \mu\text{m}$ . Phialides mixed with appressoria, alternate to opposite, ampulliform,  $11-16 \times 8-11 \mu\text{m}$ . Mycelial setae scattered, fairly numerous, simple, straight, dichotomously branched, up to  $250 \mu\text{m}$  long up to first branching, first ray up to  $70 \mu\text{m}$  long, second ray up to  $5 \mu\text{m}$  long, acute to dentate at the tip, branches reflexed. Perithecia scattered, verrucose, up to  $180 \mu\text{m}$  in diameter; ascospores obovoidal to subellipsoidal, 4-septate, constricted at the septa,  $44-50 \times 20-23 \mu\text{m}$ .

*Meliola tapiriae* Stev. & Tehon and *M.brachydenta* Sydow var. *dammeri* Hansf. are the two taxa reported on *Tapiria* sp. and *Rhus villosa* from British Guiana and Uganda having dichotomously branched mycelial setae. However, the new species differs from both in having alternate and opposite appressoria and differ in ascospore measurements (Hansford, 1961; Hosagoudar, 1996; Hosagoudar & al. 1997; Hosagoudar & Agarwal, 2008).

This species is named in honour of Dr. M. Sanjappa, Director, Botanical Survey of India for his contribution to Fabaceae.

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### भारत के मेलिओलेल्स में परिवर्धन

वी बी होसगौडार, जैकब थामस एवं डी के अग्रवाल

#### सार संक्षेप

इस शोधपत्र में केरल राज्य से संग्रह किए गए तीन वंशों के अंतर्गत सात नये मेलिओलेसिअस कवक; यथा एमेजोनिआ डिकोसिंहई, एस्टेरिडिएला एमोमी, मेलिओला एगेनोपिस, मेलिओला करेटिएड, मेलिओला सिपेडेसेड, मेलिओला मेसुएड एवं मेलिओला संजप्पाई का विस्तृत अभिलेख एवं चित्रांकन है।

## A SYNOPTIC FLORA OF LIVERWORTS AND HORNWORTS OF MANIPUR

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### ABSTRACT

The flora includes 111 species and one variety belonging to 46 genera and 20 families of liverworts and seven species belonging to three genera in family Anthocerotaceae of the hornworts from Manipur. Of these 92 taxa (91 species and 01 variety) are recorded for the first time from the State of Manipur. *Bazzania orientalis* (Steph.) Parihar, is new to the Himalayan region, whereas *Porella madagascariensis* (Nees & Mont.) Trevis. and *Phaeoceros kashyapii* A.K.Asthana & S.C.Srivast. are new to the East Himalayan bryo-geographical region.

**Keywords :** First records, liverworts, hornworts, Manipur, Synoptic key.

### INTRODUCTION

The State of Manipur, one of the seven-sister states of North-east India, is situated between 23°50' to 25°41' N latitudes and 93°6' to 94°47' E longitudes and covers an area of 22,327 sq. km. The major portion of the state is covered by hill ranges with the altitudes ranging between 550 – 3,600 m above mean sea level. Politically divided into nine districts, the State is bound on the north by the State of Nagaland, Mizoram and Chin Hills of Myanmar on south, Chindwin district of Myanmar on the east and Cachar and North Cachar districts of Assam on the west. The minimum temperature ranges between 1 – 3°C during January, while the maximum temperature varies from 32 – 38°C during August – September. The annual rainfall ranges between 1600 – 3430 mm, while the humidity ranges between 80 – 96% during July – September and 45% during March. Such diverse topography and phytoclimatic conditions support a rich growth of bryophytes, including liverworts and the hornworts.

George Watt was perhaps the first person to collect liverworts from the State during the Government demarcation survey of 1881 – 82. His collections deposited in the Cryptogamic section of the Central National Herbarium, Botanical Survey of India, Howrah (CAL) include *Trichocolea tomentella* (Ehrh.) Dumort., *Plagiochila nepalensis* Lindenb. and *Riccardia levieri* Schiffn. Later, Kashyap reported *Monosolenium tenerum* Griff. from Imphal (Kashyap, 1923) and *Riccia sanguinea* Kashyap (= *R. frostii* Austin) (Kashyap, 1929) on the basis of collections by S.L. Hora in 1920. Biswas and Calder (1936) reported *Ricciocarpos natans* (L.) Corda from the Loktak lake. Chopra (1943) reported *Anthoceros punctatus* L.

However, like other states of the North-east, barring Meghalaya and Arunachal Pradesh, Manipur also got only occasional attention of bryologists from both within and outside the country. D.B. Deb made sporadic bryological collections in and around Imphal valley during 1951 – 53 and reported *Ricciocarpos natans* (L.) Corda from Loktak lake (Deb, 1954). Based on his collections, Kachroo and Deb (1954) reported *Phaeoceros laevis* (L.) Prosk. (= *Anthoceros laevis* L.), *Marchantia paleacea* Bertol. subsp. *paleacea* (= *Marchantia nepalensis* Lehm. & Lindenb.), *Marchantia linearis* Lehm. & Lindenb., *Asterella blumeana* (Nees) Kachroo, *Asterella wallichiana* (Lehm. & Lindenb.) Pandé & al. ex Grolle (= *Asterella sanguinea* (Lehm. & Lindenb.) Kachroo), *Reboulia hemisphaerica* (L.) Raddi (= *Reboulia hemisphaerica* (L.) Raddi var. *pangiensis* Kashyap), *Plagiochasma appendiculatum* Lehm. & Lindenb., *Ricciocarpos natans* (L.) Corda, *Jamesoniella elongella* (Taylor) Steph., *Heteroscyphus argutus* (Reinw. & al.) Schiffn. [= *Chiloscyphus argutus* (Reinw. & al.) Nees] and *Chiloscyphus himalayensis* Steph. from the State. Jagdish Lal and B.D. Kar made extensive collections of bryophytes from the state during 1978 and later J.P. Ghosh collected liverworts and hornworts from the state during 1984. Based on these collections Lal (1979a, 1979b, 2003) reported *Frullania tuyamae* S.Hatt. & Thaithong and *Metzgeria nilgiriensis* Udar & S.C.Srivast. from Ukhrul. Adarsh Kumar and U.S. Awasthi made extensive collections of liverworts and hornworts from the state, especially in and around Imphal Valley and Ukhrul, during 1979. Based on these collections deposited in LWU, Kumar and

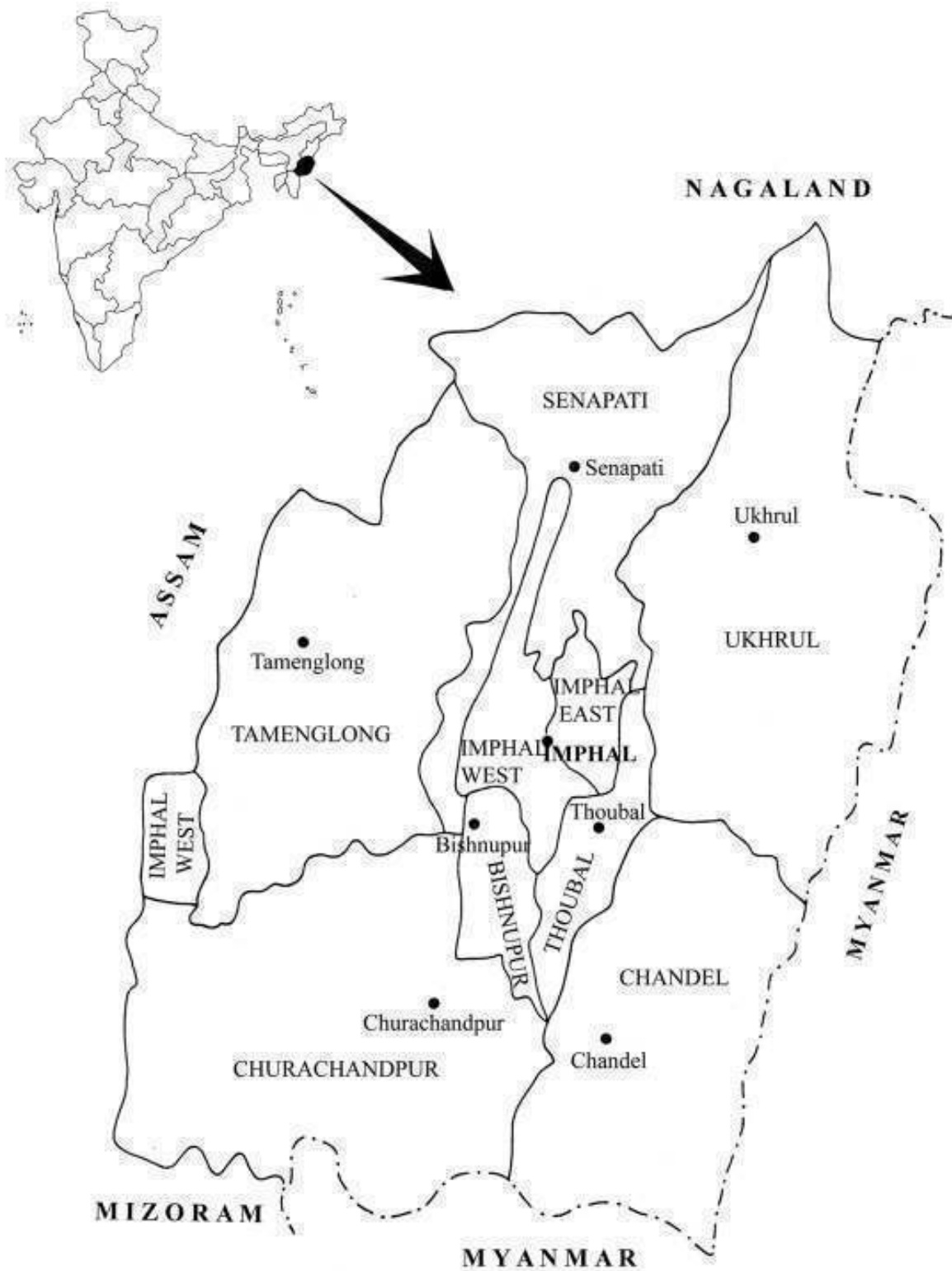


Fig. 1. Map of Manipur.

Udar (1985) described *Jamesoniella elongella* (Taylor) Steph. in detail from Ukhrul; Asthana and Srivastava (1991) reported *Anthoceros bharadwajii* Udar & A.K. Asthana, *Anthoceros erectus* Kashyap, *Phaeoceros carolinianus* (Michx.) Prosk. (= *Phaeoceros laevis* (L.) Prosk. subsp. *carolinianus* Prosk.) and *P. laevis* (L.) Prosk. (= *P. laevis* (L.) Prosk. subsp. *laevis*) from Ukhrul; Awasthi & al. (2000) reported *Lopholejeunea nigricans* (Lindenb.) Schiffn. (= *L. sikkimensis* Steph.) from Kanchipur; Srivastava and Srivastava (2002) reported *Heteroscyphus argutus* (Reinw. & al.) Schiffn. from Kanchipur in Imphal valley and Ukhrul and *H. pandei* S.C. Srivast. & Abha Srivast. from Kanchipur and Asthana and Srivastava (2003) reported *Cololejeunea latilobula* (Herzog) Tixier from Ukhrul and *C. planissima* (Mitt.) Abeyw. from Kanchipur and Ukhrul. Sharma and Srivastava (1993) reported *Lepidozia reptans* (L.) Dumort. from Manipur on the basis of collections by G. Watt. Rawat and Srivastava (2007) reported 3 species, viz. *Plagiochila parvifolia* Lindenb. and *P. perserrata* Herzog based on the collections of Adarsh Kumar and U.S. Awasthi from Vishnupur and *P. uniformis* Mitt. on the basis of collections of George Watt from an unknown locality in the State.

The present checklist is an assimilation of the published information available to the authors on the liverworts and hornworts of Manipur and the inferences derived from the critical examination of the specimens deposited in the Cryptogamic section of the Central National Herbarium, Botanical Survey of India, Howrah (CAL). The taxa enumerated here, however, do not represent an exhaustive list as not only the major portion of the State is still bryologically unexplored, but even the collections made so far and deposited in herbaria outside BSI have yet not been fully worked out.

## SYNOPSIS OF THE FLORA

### ORDER JUNGERMANNIALES (87)

**Herbertaceae:** *Herbertus* (2); **Trichocoleaceae:** *Trichocolea* (2); **Lepidoziaceae:** *Bazzania* (8), *Lepidozia* (1); **Cephaloziaceae:** *Cephalozia* (1), *Odontochisma* (1); **Jungermanniaceae:** *Anastrepta* (1), *Anastrophyllum* (1), *Jamesoniella* (1), *Notoscyphus* (1), *Plicanthus* (1), *Solenostoma* (2); **Geocalycaceae:** *Chiloscyphus* (1), *Heteroscyphus* (6), *Lophocolea* (1); **Plagiochilaceae:** *Plagiochila* (10); **Radulaceae:** *Radula* (3); **Porellaceae:** *Porella* (4/1); **Jubulaceae:** *Frullania* (8), *Jubula* (1); **Lejeuneaceae:** *Cheilolejeunea* (2), *Cololejeunea* (8), *Drepanolejeunea* (3), *Lejeunea* (8), *Leptolejeunea* (2), *Lopholejeunea* (1), *Mastigolejeunea* (1), *Ptychanthus* (1), *Spruceanthus* (1), *Trocholejeunea* (2), *Tuzibeanthus* (1).

### ORDER METZGERIALES (10)

**Pelliaceae:** *Pellia* (1); **Aneuraceae:** *Aneura* (1); **Riccardia** (3); **Metzgeriaceae:** *Apometzgeria* (1), *Metzgeria* (4).

### ORDER MARCHANTIALES (15)

**Targioniaceae:** *Targionia* (1); **Conocephalaceae:** *Conocephalum* (1); **Aytoniaceae:** *Asterella* (3), *Plagiochasma* (1), *Reboulia* (1); **Monosoleniaceae:** *Monosolenium* (1); **Marchantiaceae:** *Dumortiera* (1), *Marchantia* (3); **Ricciaceae:** *Riccia* (2), *Ricciocarpos* (1).

### ORDER ANTHOCEROTALES (07)

**Anthocerotaceae:** *Anthoceros* (3), *Folioceros* (1), *Phaeoceros* (3).

#### Key to the orders, families, genera and species

- 1a. Cells usually with a single plate-like chloroplast with or without a central pyrenoid; oil-bodies absent; sporophyte indeterminate in growth, columellate or not; antheridia endogenous; capsule long cylindrical with basal meristematic zone, bivalved; capsule wall with or without stomata; true elaters absent (except *Megaceros* and *Dendroceros*) ... 2. (Anthocerotales) Anthocerotaceae
- 1b. Cells with numerous chloroplast; oil-bodies usually present; sporophyte determinate in growth; antheridia exogenous; capsule globose – ovoid without meristematic zone and columella; capsule wall always without stomata; true elaters present (except in Ricciaceae) ... 8
- 2a. Thallus compact, without schizogenous cavities; spores yellowish with granulose – papillose sporoderm ... 3. *Phaeoceros*



- 2b. Thallus with schizogenous cavities; spores dark brown – black with spinose – baculate, reticulate – reticuloid sporoderm ... 5
- 3a. Sporoderm with lamellate marking ... *P. kashyapii*
- 3b. Sporoderm without lamellate marking ... 4
- 4a. Plants monoecious; tri-radiate mark loosely impregnated with papillae, proximal surface with a group of papillae arranged in the center of each face ... *P. carolinianus*
- 4b. Plants dioecious; tri-radiate mark densely impregnated with papillae, proximal surface with uniformly distributed papillae in each face ... *P. laevis*
- 5a. Thallus spongy; proximal surface of spores devoid of distinct triradiate mark; sporoderm baculate; pseudoelater thick-walled with dark, narrow lumen ... *Folioceros assamicus*
- 5b. Thallus not spongy; proximal surface of spores with a distinct and bold triradiate mark; sporoderm reticulate; pseudoelater thin-walled with light, broad lumen ... 6. *Anthoceros*
- 6a. Capsule wall with 6 – 11 stomata/sq. mm; sporoderm reticuloid – pseudolamellate ... *A. bharadwajii*
- 6b. Capsule wall with 5 – 8 or 7 – 9 stomata/sq. mm; sporoderm reticulate ... 7
- 7a. Reticulations of sporoderm studded with thick tubercles with blunt apices; trilete mark of proximal face bordered on both sides by unsculptured stripe ... *A. erectus*
- 7b. Reticulations of sporoderm studded with spines with subacute, occasionally bifurcating apices; trilete mark of proximal face not bordered by unsculptured stripe ... *A. punctatus*
- 8a. Plant body always thalloid; dorsal pores and air chambers usually present; rhizoids usually tuberculate and smooth-walled; ventral scales always present; sporophyte highly reduced; sporogonium not exerted at maturity; capsule wall single-layered ... 9. *Marchantiales*
- 8b. Plant body either leafy or thalloid; dorsal pores and air chambers absent; rhizoids only smooth-walled; ventral scales usually absent; sporophyte well developed; sporogonium exerted at maturity on a long seta; capsule wall 2 – many-layered ... 23
- 9a. Sporophyte completely embedded in thallus, without a distinct foot and seta; capsules cleistocarpous; elaters absent ... 10. *Ricciaceae*
- 9b. Sporophyte not embedded in thallus, with distinct foot and seta; capsule never cleistocarpous, dehiscing by means of operculum or valve; elaters present ... 12
- 10a. Plants free-floating, aquatic; epidermal pores distinct; ventral surface with numerous conspicuous linear, serrulate sword-like or lingulate ventral scales; antheridia and archegonia in median grooves ... *Ricciocarpos natans*
- 10b. Plants terrestrial, epidermal pores absent or reduced; ventral surface never with sword-like or lingulate ventral scales; antheridia and archegonia scattered in thallus ... 11. *Riccia*
- 11a. Plants monoecious; thallus *Euriccia*-type; spores 80 – 150 µm in diameter; sporoderm reticulate ... *R. billardieri*
- 11b. Plants dioecious; thallus *Ricciella*-type; spores 42 – 60 µm in diameter; sporoderm lamellate ... *R. frostii*
- 12a. Sporophyte not aggregated into archegoniophores, solitary, terminal yet superficially displaced ventrally, enclosed within naviculate, bilabiate involucre ... (Targioniaceae) *Targionia hypophylla*

- 12b. Sporophyte aggregated into dorsal or terminal complex, sub sessile or stalked archegoniophores, never solitary, not enclosed in bilabiate involucre ... 13
- 13a. Thallus not differentiated into assimilatory and storage zones; pores absent; spores usually in tetrads; elaters 1 – 3-celled, reduced, chlorophyllose ... (Monosoleniaceae) *Monosolenium tenerum*
- 13b. Thallus well differentiated into assimilatory and storage zones; pores well developed (reduced in *Dumortiera*); spores not united; elaters well developed ... 14
- 14a. Air-chambers with nonchlorophyllose partitions; terminal cells of photosynthetic filaments beak-like near pore; appendages of ventral scale reniform; spores isopolar; sporoderm granulate – papillate ... (Conocephalaceae) *Conocephalum conicum*
- 14b. Air-chambers with chlorophyllose partitions; terminal cells of photosynthetic filaments not beak like; appendages of the ventral scale never reniform; spores anisopolar; sporoderm reticulate – lamellate ... 15
- 15a. Epidermal pores of thallus compound, formed of several super imposed rings of cells, barrel-shaped (reduced or absent in *Dumortiera*); gemma present (except in *Dumortiera*) capsule wall with thickening ... 16. Marchantiaceae
- 15b. Epidermal pores of thallus simple, formed of a single layer of cells, not barrel-shaped; gemmae absent; capsule wall devoid of thickenings ... 19. Aytoniaceae
- 16a. Plants translucent; epidermal pores and air chambers vestigial or absent; ventral scales vestigial or absent; gemma cup absent; antheridiophores sessile; both male and female receptacles having bristles on margins ... *Dumortiera hirsuta*
- 16b. Plants not translucent; epidermal pores and air chambers well developed; ventral scales well developed in 4 – 6 rows; gemma cup present; antheridiophores stalked; both male and female receptacles devoid of bristles at margins ... 17. *Marchantia*
- 17a. Plants 7 – 11 mm wide, without mid-dorsal line; inner opening of epidermal pores highly constricted; appendage of ventral scale with obtuse – acute apices, 12 – 20 cells wide in the middle ... *M. paleacea*
- 17b. Plants 3 – 6 mm wide, with distinct mid-dorsal line; inner opening of epidermal pores prominent; appendage of ventral scale with apiculate – acuminate or sometimes acute apices, 5 – 12 cells wide in the middle ... 18
- 18a. Appendage of ventral scales broadly ovate – oblong-ovate, 7 – 14 cells wide in the middle, apex 1 – 3 cells uniseriate towards apex; female receptacle 6 – 9-lobed, dorsal surface smooth ... *M. linearis*
- 18b. Appendage of ventral scales lanceolate, 5 – 7 cells wide in the middle, apex 4 – 7 cells uniseriate towards apex; female receptacle 4 – 6-lobed, dorsal surface verrucose by large projecting epidermal pores ... *M. subintegra*
- 19a. Plants foetid, smelling like fish; antheridiophore cushion-shaped, borne on lateral adventitious branches; archegoniophore always terminal; pseudoperianth present, beak-like; capsule surrounded by an exerted sheath 20. *Asterella*
- 19b. Plants not foetid; antheridiophores terminal on the main thallus or just behind the archegoniophore, horse-shoe-shaped or disciform; archegoniophore dorsal or terminal; pseudoperianth absent; capsule not surrounded by an exerted sheath ... 22
- 20a. Plants dioecious; spores 62.5 – 87.5 µm in diameter; sporoderm with wavy ridges on both distal and proximal surface ... *A. wallichiana*

- 20b. Plants monoecious; spores 70.0 – 100.0 µm in diameter; sporoderm reticulate on both distal and proximal surface ... 21
- 21a. Distal surface of spore with large primary reticulations 11 – 23 µm in diameter, which are again minutely reticulated ... *A. khasyana*
- 21b. Distal surface of spore with small reticulations 1.5 – 3 µm in diameter ... *A. blumeana*
- 22a. Plants monoecious; ventral scales with a single rounded, ovate or broadly triangulate appendage; male receptacle horse-shoe-shaped; female receptacle dorsal ... *Plagiochasma appendiculatum*
- 22b. Plants dioecious; ventral scales with 1 – 2 (– 3) linear – lanceolate appendage; male receptacle disciform; female receptacle terminal ... *Reboulia hemisphaerica*
- 23a. Plant body usually thalloid, sometimes leafy; when leafy, not clearly differentiated into stem and leaves; rhizoids scattered; sporophyte anacrogynous, dorsal, ventral or lateral in position, never in the axil of leaf ... 24. Metzgeriales
- 23b. Plant body usually differentiated into stem and leaves; rhizoids scattered or fasciculate; sporophyte acrogynous, terminal on main or lateral branches, always in the axil of leaves ... 33. Jungermanniales
- 24a. Thallus always broad, light – pale green, often pigmented; midrib and hairs absent; male gametangia not defined, antheridia scattered on dorsal surface; gynoecia strictly dorsal; capsules spherical, never with terminal elaterophore ... (Pelliaceae) *Pellia epiphylla*
- 24b. Thallus broad, dark green, without midrib and hairs, or linear, light – pale green, with midrib and hairs; both androecia and gynoecia on lateral or ventral branches; capsules ovoid, ellipsoid or cylindrical; terminal elaterophores present ... 25
- 25a. Thallus not differentiated into midrib and wing; hairs absent; androecia and gynoecia borne on lateral branches ... 26. Aneuraceae
- 25b. Thallus well differentiated into midrib and unistratose wing; hairs present; androecia and gynoecia borne on ventral branches ... 29. Metzgeriaceae
- 26a. Thallus 2.5- 5 mm broad, simple – furcate; seta 8 – 12 cells across the diameter with numerous outer and inner cells ... *Aneura maxima*
- 26b. Thallus narrow, 0.3 – 1.5 (– 2) mm broad; profusely pinnately – palmately or irregularly branched; seta 4 cells across the diameter with 11 – 12 outer and 4 inner cells ... 27. *Riccardia*
- 27a. Plants monoecious; 0.3 – 0.4 mm wide; transverse section of main thallus 4 – 6 cells thick ... *R. tenuicostata*
- 27b. Plants dioecious; 0.6 – 1.2 mm wide; transverse section of main thallus 6 – 13 cells thick ... 28
- 28a. Transverse section of main thallus 6 – 9 cells thick; primary branches 3 – 4 cells thick; cells with pigmented walls absent ... *R. levieri*
- 28b. Transverse section of main thallus 11 – 14 cells thick; primary branches 6 – 7 cells thick; cells with pigmented walls present ... *R. sikkimensis*
- 29a. Midrib with 6 – 9 epidermal cells rows, more or less similar to medullary cells in transverse section; hairs present on both dorsal and ventral surface of thallus; seta 8 – 9 cells across in transverse section with about 30 outer surrounding cells and numerous inner cells ... *Apometzgeria pubescens*

- 29b. Midrib with 2 – 4 epidermal cell rows, much larger than medullary cells in transverse section; hairs absent on dorsal surface, sometimes present only on the ventral surface of thallus; seta 4 – 6 cells across in transverse section with 14 – 16 outer cells surrounding 5 – 9 inner cells ... 30. *Metzgeria*
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- 30b. Plants monoecious; gemmae absent ... 32
- 31a. Plants tubular – ribbon like; marginal hairs paired, falcate ... *M. leptoneura*
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- 32a. Hairs present on ventral surface of thallus and male branches; ventral epidermal cells of midrib in 2 – 4 rows; spores densely tuberculate ... *M. conjugata*
- 32b. Hairs absent on ventral surface of thallus and male branches; ventral epidermal cells of midrib in 2 rows; spores finely granulose ... *M. lindbergii*
- 33a. Leaves isophyllous, arranged in 3 equal rows; vitta cells present, extending in to the lobes of leaf and underleaf ... 34. (Herbertaceae) *Herbertus*
- 33b. Leaves anisophyllous, not arranged in 3 equal rows; vitta cells absent (except in some species of *Plagiochila* and *Cololejeunea*) ... 35
- 34a. Stem 0.14 – 0.20 x 0.12 – 0.18 mm, 9 – 13 cells across diameter; cortical cells in 2 layers; leaves oblong, bilobed to 3/5 – 2/3 of lobe length, leaf length / width ratio 2.6:1 – 3.3:1 ... *H. aduncus*
- 34b. Stem 0.35 – 0.40 x 0.30 – 0.35 mm, 14 – 18 cells across diameter; cortical cells in 2 – 3 layers; leaves ovate, bilobed to 2/5 – 1/2 of lobe length, leaf length/width ratio 1.6:1 – 2.0:1 ... *H. dicranus*
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- 37b. Stem 0.5 – 0.8 x 0.35 – 0.6 mm, 20 – 30 cells across diameter; cortical cells in 3 – 4 layers, thick-walled; paraphyllia abundant; leaves (4 –) 5 – 7 (– 8)-lobed ... *T. tomentella*
- 38a. Plants regularly 1 – 2 (– 3) pinnately branched or monopodial; branching *Microlepidozia*-type; leaves and underleaves deeply lobed ... *Lepidozia reptans*
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- 81a. Leaf lobules galeate, cucullate, or explanate; hyaline papilla absent in lobules; (1 –) 2 – 5 archegonia per gynoeceum ... 82. Jubulaceae
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- 82a. Leaf cells with minute trigones, devoid of intermediate thickenings; male bracteoles present throughout the androecium; gynoecia with 1 – 2 sub floral innovations of *Radula*-type; seta with 16 outer cells surrounding 4 inner cells; spores without rosette-like ornamentations ... *Jubula pennsylvanica*
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- 118b. Leaf lobes oblong – ovate with obtuse – slightly rounded apices;  
leaf cells without intermediate thickenings; stylus present ... *C. trichomanis*

## ENUMERATION

## HERBERTACEAE

**Herbertus aduncus** (Dicks.) Gray, Nat. Arr. Brit. Pl. 1: 705. 1821; Juslén in Ann. Bot. Fenn. 43: 413. 2006. *Jungermannia adunca* Dicks., Pl. Crypt. Brit. Fasc. 3: 12. 1793. *Herbertus darjeelingensis* H.A.Mill. in J. Hattori Bot. Lab. 28: 307. 1965. *Herbertus fragilis* (Steph.) H.A.Mill. in J. Hattori Bot. Lab. 28: 311. 1965. subsp. **aduncus**.

*Specimen examined* : Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1253B).

*Distribution* : India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, China, Japan, Philippines, Korea, Canada, USA (Herzog, 1939; Hattori, 1966, 1971, 1975; Miller, 1965; Tan & Engel, 1986; Piippo, 1990; Juslén, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & Nath, 2007).

**Herbertus dicranus** (Taylor ex Gottsche & al.) Trevis. in Mem. R. Istit. Lombardo Sci. (ser. 3) 4: 397. 1877; Juslén in Ann. Bot. Fenn. 43: 419. 2006. *Schisma dicrana* Taylor ex Gottsche & al., Syn. hepat. 239. 1845. *Herberta chinensis* Steph. in Hedwigia 34: 43. 1895. *Herberta fleischeri* (Steph.) H.A.Mill. in J. Hattori Bot. Lab. 28: 307. 1965. *Herberta himalayana* (Steph.) H.A.Mill. in J. Hattori Bot. Lab. 28: 319. 1965. *Herberta nicholsonii* Herzog in Ann. Bryol. 12: 80. 1939. *Herberta mastigophoroides* Herzog & W.E. Nicholson ex H.A.Mill. in J. Hattori Bot. Lab. 28: 324. 1965. *Herberta pinnata* (Steph.) H.A.Mill. in J. Hattori Bot. Lab. 28: 299. 1965. *Herberta pseudoceylanica* S. Hatt. in Hara, The Flora of Eastern Himalaya 2: 225. 1971. *Herberta sikkimensis* (Steph.) W.E. Nicholson in Handel-Mazzetti, Symb. sin. 5: 28. 1930. *Herberta wichurae* Steph. in Hedwigia 34: 45. 1895.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1254A).

*Distribution*: India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal); Western Ghats (Tamil Nadu)], Nepal, Bhutan, China, Sri Lanka, Indonesia, Philippines, Japan, Malaysia, Thailand, Vietnam, Hawaii, New Caledonia, Uganda, Kenya, Tanzania, Rwanda, DR Congo, Madeira, Mauritius, Réunion, Canada, USA (Chopra, 1938, 1943; Herzog, 1939; Miller, 1965; Hattori, 1966, 1971, 1975; Piippo, 1990; Long, 1979; Long & Grolle, 1990; Juslén, 2006; Singh & Nath, 2007; Lai & al., 2008).

## TRICHOCOLEACEAE

**Trichocolea tenera** Udar & D. K. Singh in Geophytology 7: 69. 1977; A. P. Singh & V. Nath, Hepaticae of Khasi and Jaintia Hills: Eastern Himalayas 11. 2007.

*Specimen examined* : Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1521B).

*Distribution* : India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)] (Udar & Singh, 1977; Singh & Nath, 2007; Dey & al., 2009).

**Trichocolea tomentella** (Ehrh.) Dumort. in Nees, Naturgesch. eur. Leberm. 3 (1838) 105; Mitt. in J. Proc. Linn. Soc., Bot. 5: 103. 1861. *Jungermannia tomentella* Ehrh., Beitr. Zur Nat. 2: 150. 1788.

*Specimen examined* : Terricolous. India: Eastern Himalaya, Manipur, 1881 – 1882, G. Watt 6579.

*Distribution* : India [Eastern Himalaya (Manipur – present study, Sikkim, West Bengal)], Bhutan, China, Japan, Thailand, Indonesia, Philippines, Europe, North America (Mitten, 1861; Hattori, 1966;

Long, 1979; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Yamada & Iwatsuki, 2006; Lai & al., 2008).

#### LEPIDOZIACEAE

**Bazzania appendiculata** (Mitt.) S.Hatt. in Hara, Flora of Eastern Himalaya 505. 1966; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 128. 1993. *Mastigobryum appendiculatum* Mitt. in J. Proc. Linn. Soc., Bot. 5: 105. 1861. *Mastigobryum cuspidatum* Steph., Sp. hepat. 3: 495. 1908.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1255).

*Distribution* : India [Eastern Himalaya (Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, China, Myanmar, Thailand (Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh & Nath, 2007; Lai & al., 2008).

**Bazzania himalayana** (Mitt.) Schiffn. in Oesterr. Bot. Z. 49: 132. 1899; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 111. 1993. *Mastigobryum himalayanum* Mitt. in J. Proc. Linn. Soc., Bot. 5: 105. 1861. *Mastigobryum gammianum* Steph., Sp. hepat. 3: 461. 1908. *Mastigobryum rupicolum* Steph., Sp. hepat. 6: 479. 1924.

*Specimen examined* : Corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1256); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1257).

*Distribution* : India [Eastern Himalaya (Meghalaya, Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, China, Philippines, Thailand (Mitten, 1861; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh & Nath, 2007; Lai & al., 2008).

**Bazzania orientalis** (Steph.) Parihar, An annotated revised census of Indian hepatics 6. 1961 – 1962. *Mastigobryum orientale* Steph., Sp. hepat. 6: 476. 1924.

*Specimen examined* : Terricolous. India: Eastern Himalaya, Manipur, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1258).

*Distribution* : India [Eastern Himalaya (Manipur – present study), Western Ghat (Tamil Nadu)] (Sharma & Srivastava, 1993).

**Bazzania ovistipula** (Steph.) Abeyw. in Ceylon J. Sci. 2: 1: 45. 1959; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 135. 1993. *Mastigobryum ovistipulum* Steph., Sp. hepat. 3: 444. 1908. *Bazzania nudistipula* Pandé & al., Proc. 36th Indian Sci. Cong. 9. 1949. *Bazzania pusilla* (Steph.) S. Hatt. in Hara, Flora of Eastern Himalaya 506. 1966.

*Specimen examined* : Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1259).

*Distribution* : India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghat (Karnataka)], Sri Lanka, Bhutan, Nepal, China, Philippines, Thailand, Vietnam, Japan (Onraedt, 1981; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh, 1996; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Bazzania praerupta** (Reinw. & al.) Trevis., Mem. R. Istit. Lombardo (ser. 3) 4: 414. 1877; D. Sharma & S. C. Srivast. in Bryophyt. Biblioth. 47: 151. 1993. *Jungermannia praerupta* Reinw. & al. in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 229. 1824. *Bazzania decurva* (Nees) Trevis., Mem. R. Istit. Lombardo (ser. 3) 4: 414. 1877. *Mastigobryum praeruptum* (Reinw. & al.) Lindenb. in Gottsche & al., Syn. hepat. 224. 1845.

*Specimen examined* : Terricolous and corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1260, 1253A); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1261).

*Distribution* : India [Eastern Himalaya (Arunachal Pradesh, Meghalaya, Manipur – present study, Sikkim, West Bengal), Western Himalaya (Uttarakhand), Western Ghat], Sri Lanka, Bhutan, Nepal, China,

Myanmar, Philippines, Indonesia, Thailand, Japan, Vietnam, Hawaii (Onraedt, 1981; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh, 1996; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Bazzania sumbavensis** (Gottsche ex Steph.) Steph. in Hedwigia 32: 204. 1893; D.Sharma & S.C.Srivast. in Bryophyt. Biblioth. 47: 107. 1993. *Mastigobryum sumbavense* Gottsche ex Steph. in Hedwigia 25: 236. 1886.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Thengnoupal district, Moreh, c.1391 m, 26.03.1984, J.P. Ghosh 58073.

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, Thailand, Indonesia, New Guinea, Samoa (Long & Grolle, 1990; Sharma & Srivastava, 1993; Singh & Nath, 2007; Lai & al., 2008).

**Bazzania tricrenata** (Wahlenb.) Lindb. in Brothierus, Musci Fenn. Exs., (Fasc. 2): 2. 1872; D.Sharma & S.C.Srivast. in Bryophyt. Biblioth. 47: 143. 1993. *Jungermannia tricrenata* Wahlenb., Fl. carpath. 364. 1814. *Mastigobryum deflexum* (Mart.) Gottsche in Gottsche & al., Syn. hepat. 231. 1835. *Mastigobryum longanum* Steph., Sp. hepat. 6: 472. 1924. *Mastigobryum perrottetii* Steph., Sp. hepat. 3: 434. 1909.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1263).

*Distribution:* India [Western Himalaya (Himachal Pradesh); Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal); Western Ghats (Tamil Nadu)], Nepal, Bhutan, China, Korea, Japan, Europe, North America, (Schuster, 1969; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh, 1996; Song & Yamada, 2006; Yamada & Iwatsuki, 2006).

**Bazzania tridens** (Reinw. & al.) Trevis., Mem. R. Institut. Lombardo (ser. 3) 4: 415. 1877; D.Sharma & S.C.Srivast. in Bryophyt. Biblioth. 47: 121. 1993. *Jungermannia tridens* Reinw. & al. in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.12: 228. 1824. *Mastigobryum cardotii* Steph., Sp. hepat. 3: 515. 1908. *Mastigobryum oblongum* Mitt. in J. Proc. Linn. Soc., Bot. 5: 106. 1861. *Mastigobryum pinniformae* Steph., Sp. hepat. 3: 462. 1908. *Mastigobryum tridens* (Reinw. & al.) Nees in Gottsche & al., Syn. hepat. 227. 1845. *Bazzania lobulistipa* (Steph.) S.Hatt. in Hara, Flora of eastern Himalaya 505. 1966. *Bazzania pinniformis* (Steph.) S.Hatt. in Hara, Flora of Eastern Himalaya 506. 1966.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1264, 1265, 1266, 1267, 1268C).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghat (Tamil Nadu)], Sri Lanka, Nepal, Bhutan, China, Myanmar, Philippines, Indonesia, Japan, Korea, Thailand, Vietnam, Samoa, Australia (Onraedt, 1981; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Singh, 1996; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Lepidozia reptans** (L.) Dumort., Recueil observ. Jungerm. 19: 1835; D.Sharma & S.C.Srivast. in Bryophyt. Biblioth. 47: 64. 1993. *Jungermannia reptans* L., Sp. pl. 2: 1133. 1753. *Lepidozia tridens* Steph., Sp. hepat. 3: 617. 1909. *Lepidozia macrocalyx* Steph. in Mem. Soc. Sci. Nat. Cherbourg 29: 216. 1894. *Lepidozia hokiensis* Steph. in Mem. Soc. Nat. Math. Cherbourg. 29: 216. 1894. *Lepidozia himalayensis* Steph., Sp. hepat. 3: 617. 1909.

Manipur, G. Watt, 438 (G) (fide Sharma & Srivastava, loc.cit.).

*Distribution:* India [Western Himalaya (Jammu and Kashmir, Uttarakhand); Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal); Western Ghats (Tamil Nadu)], Nepal, Bhutan, China, Pakistan, Japan, Philippines, Thailand, Europe, North, Central and South America (Kashyap, 1932; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Sharma & Srivastava, 1993; Piippo & al., 1997; Yamada & Iwatsuki, 2006; Singh & Nath, 2007).

## CEPHALOZIACEAE

**Cephalozia darjeelingensis** Udar & D.Kumar in Geophytology 6: 36. 1976.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1269C).

*Distribution*: India [Eastern Himalaya (Manipur – present study, West Bengal)], Bhutan (Udar & Kumar, 1976; Long & Grolle, 1990).

**Odontoschisma denudatum** (Nees) Dumort., Recueil observ. Jungerm. 19. 1835; D.G. Long in Cryptogamie, Bryol. 26: 99. 2005. *Jungermannia denudata* Nees in Mart., Fl. Crypt. Erlang. 14. 1817.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1270, 1271).

*Distribution*: India [Eastern Himalaya (Manipur – present study, Sikkim)], Nepal, China, Japan, Thailand, Europe, South Africa, North, Central, and South America (Hattori, 1971; Schuster, 1974; Long & Grolle, 1990; Piippo, 1990; Long, 2005; Yamada & Iwatsuki, 2006; Lai & al., 2008).

## JUNGERMANNIACEAE

**Anastrepta orcadensis** (Hook.) Schiffn. in Engl. & Prantl, Nat. Pflanzenfam. 3: 85. 1893; S.Hatt. in Hara, Flora of Eastern Himalaya 507. 1966. *Jungermannia orcadensis* Hook., Brit. Jungermann. 71. 1814. *Anastrepta sikkimensis* Steph., Sp. hepat. 6: 19. 1917.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1272).

*Distribution*: India [Eastern Himalaya (Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, China, Japan, Hawaii, Europe, North America (Chopra, 1938, 1943; Herzog, 1939; Hattori, 1966; Kitagawa, 1966; Long, 1979; Long & Grolle, 1990; Piippo, 1990; Yamada & Iwatsuki, 2006).

**Anastrophyllum joergensenii** Schiffn. in Hedwigia 49: 396. 1910; D.Schill & D.G.Long in J. Hattori Bot. Lab. 94: 139. 2003. *Anastrophyllum alpinum* Steph., Sp. hepat. 6: 103. 1917.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no.1273).

*Distribution*: India [Western Himalaya (Uttarakhand); Eastern Himalaya (Manipur – present study, Sikkim)], Nepal, Bhutan, China, Europe (Chopra, 1943; Hattori, 1966, Long & Grolle, 1990; Piippo, 1990; Paton, 1999; Nath & al., 2002; Schill & Long, 2003).

**Jamesoniella elongella** (Taylor) Steph., Sp. hepat. 2: 93. 1906; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954; Adarsh Kumar & Udar in Geophytology 15: 2. 1985. *Jungermannia elongella* Taylor in J. Bot. 5: 274. 1846.

Ukhrul, c.1860 m (fide Kumar & Udar, loc.cit.).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand); Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim)], Nepal, Bhutan, China, Sri Lanka (Kashyap, 1932; Kachroo & Deb, 1954; Kumar & Udar, 1985; Long & Grolle, 1990; Piippo, 1990; Singh & Nath, 2007; Singh & Singh, 2009).

**Solenostoma comatum** (Nees) C.Gao, Fl. Hepat. Chin. Boreali-Orient. 73. 1981; Vana & D.G.Long in Nova Hedwigia 89: 497. 2009. *Jungermannia comata* Nees, Hepat. Jav. 78. 1830. *Jungermannia stevensiana* Steph., Sp. hepat. 6: 93. 1924.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1274, 1275).

*Distribution*: India [Eastern Himalaya (Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, China, Korea, Japan, Myanmar, Philippines, Thailand, Indonesia, Malaysia, New Guinea (Amakawa, 1960, 1970; Váða, 1972; Tan & Engel, 1986; Piippo, 1990; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008; Singh & al., 2008a; Váða & Long, 2009).



**Solenostoma truncatum** (Nees) R.M.Schust. ex Vana & D.G.Long in Nova Hedwigia 89: 509. 2009. *Jungermannia truncata* Nees, Hepat. Jav. 29. 1830. *Jungermannia polyrhiza* Hook., in Lehmann, 6: 34. 1834.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1276, 1277, 1278); Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1279).

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Pakistan, Nepal, Bhutan, Sri Lanka, China, Japan, Indonesia, Myanmar, Philippines, Thailand, Australia (Chopra, 1943; Amakawa, 1972; Váða, 1974; Hattori, 1975; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Yamada & Iwatsuki, 2006; McCarthy, 2006; Lai & al., 2008; Váða & Long, 2009).

**Notoscyphus darjeelingensis** Udar & A.Kumar in J. Hattori Bot. Lab. 49: 250. 1981.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tusshen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1280).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal)] (Udar & Kumar, 1981; Singh, 1996; Dey & al., 2009).

**Plicanthus hirtellus** (F.Weber) R.M.Schust. in Nova Hedwigia 74: 492. 2002. *Jungermannia hirtella* F.Weber, Hist. Musc. Hep. Prodr. 50. 1815. *Chandonanthus hirtellus* (F.Weber) Mitt. in Hooker, Handb. New Zealand Fl. 2: 861. 1857.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1281), Khangkhui forest, 26.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1282, 1283, 1284).

*Distribution:* India: Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Nepal, Bhutan, Sri Lanka, China, Thailand, Japan, Philippines, Australia, Africa, North America (Mitten, 1861; Hattori, 1971; Long, 1979; Onraedt, 1981; Udar & Kumar, 1982; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Singh, 1996; Wigginton & Grolle, 1996; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & Nath, 2007; Lai & al., 2008).

#### GEOCALYCEAE

**Chiloscyphus himalayensis** Steph., Sp. hepat. 3 : 209. 1907; Abha Srivast. & S.C.Srivast., Indian Geocal. 122. 2002; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954.

Imphal, D.B. Deb, s.n. (fide Kachroo & Deb, loc.cit.).

*Distribution:* India [Western Himalaya (Jammu & Kashmir, Himachal Pradesh, Uttarakhand) Eastern Himalaya (Manipur)] (Kachroo & Deb, 1954; Srivastava & Srivastava, 2002; Singh & Singh, 2009).

**Heteroscyphus argutus** (Reinw. & al.) Schiffn. in Oesterr. Bot. Z. 60: 172. 1910; Abha Srivast. & S.C.Srivast., Indian Geocal. 122. 2002. *Jungermannia arguta* Reinw. & al. in Nees, Hepat. Java. 1: 206. 1824. *Chiloscyphus argutus* (Reinw. & al.) Nees in Gottsche & al., Syn. hepat. 183. 1845; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1285); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1286); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1287A).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand) Eastern Himalaya (Manipur, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Thailand, Indonesia, Korea, Japan, New Guinea, Hawaii, Australia, New Zealand (Kachroo & Deb, 1954; Onraedt, 1981; Long & Grolle, 1990; Srivastava & Srivastava, 2002; McCarthy, 2006; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Heteroscyphus bescherelei** (Steph.) S.Hatt. in Bot. Mag. (Tokyo) 58: 39. 1944; Abha Srivast. & S.C.Srivast., Indian Geocal. 105: 2002. *Chiloscyphus bescherelei* Steph. in Bull. Herb. Boissier 5: 87. 1897. *Chiloscyphus communis* Steph., Sp. hepat. 3: 211. 1906. *Lophocolea sendaica* Steph., Sp. hepat. 6: 292. 1922.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1288).

*Distribution*: India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, China, Japan, Philippines, New Guinea, Australia (Tan & Engel, 1986; Srivastava & Srivastava, 2002; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a).

**Heteroscyphus hyalinus** (Steph.) S.C.Srivast. & Abha Srivast., Indian Geocal. 118. 2002. *Lophocolea hyalina* Steph. in Bull. Acad. Soc. Roy. Sci. Belgique 38: 254. 1899. *Chiloscyphus gammianus* Steph., Sp. hepat. 3: 217. 1906.

*Specimen examined*: Terricolous and corticolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1289B); Ukhrul district, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1290); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1291).

*Distribution*: India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal (Srivastava & Srivastava, 2002; Singh & Nath, 2007; Singh & al., 2008a; Dey & al., 2009).

**Heteroscyphus orbiculatus** Abha Srivast. & S.C.Srivast., Indian Geocal. 140. 2002; Sushil K.Singh & D.K.Singh in Indian J. Forest. 26: 317. 2003.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, on way to Kangpoki, 15.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1292); Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1293); Ukhrul district, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1294).

*Distribution*: India [Western Himalaya (Himachal Pradesh), Eastern Himalaya (Manipur – present study, Sikkim), Western Ghats (Tamil Nadu)] (Srivastava & Srivastava, 2002; Singh & Singh, 2003, 2009; Dey & al., 2009).

**Heteroscyphus pandei** S.C.Srivast. & Abha Srivast. in Lindbergia 15: 197. 1989; Abha Srivast. & S.C.Srivast., Indian Geocal. 134. 2002.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1295A).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Manipur, Sikkim, West Bengal)], Nepal (Srivastava & Srivastava, 2002; Singh & Singh, 2009).

**Heteroscyphus parvus** Abha Srivast. & S.C.Srivast., Indian Geocalyaceae 112. 2002.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1296); Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1488B).

*Distribution*: India [Eastern Himalaya (Manipur – present study, Sikkim), Central India (Madhya Pradesh)], Nepal (Srivastava & Srivastava, 2002).

**Lophocolea bidentata** (L.) Dumort., Recueil observ. Jungerm. 17. 1835; Abha Srivast. & S.C.Srivast., Indian Geocalyaceae 187. 2002. *Jungermannia bidentata* L., Sp. pl. 2 2: 1132. 1753.

*Specimens examined*: Terricolous and corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1297); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1287B, 1298).

*Distribution*: India [Western Himalaya (Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Nepal, Bhutan, Korea, Europe, North, Central & South America, Africa, Australia, New Zealand (Long & Grolle, 1990; Singh, 1996; Srivastava & Srivastava, 2002; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007).

## PLAGIOCHILACEAE

**Plagiochila elegans** Mitt. in J. Proc. Linn. Soc., Bot. 5: 97. 1861; M.L. So in Syst. Bot. Monog. 60: 184. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 188. 2007. *Plagiochila consimilis* Steph., Sp. hepat. 6: 141. 1918. *Plagiochila hartlessiana* Steph., Bull. Herb. Boissier (ser. 2) 3: 881. 1903. *Plagiochila permagna* Schiffn. ex Steph., Sp. hepat. 6: 198. 1921. *Plagiochila pluridentata* Steph. in Renault and Cardot, Bull. Soc. Roy. Bot. Belgique 41, Mém. 122. 1905.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c. 1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1299).

*Distribution:* India [Western Himalaya (Himachal Pradesh); Eastern Himalaya (Manipur – present study, Sikkim, West Bengal); Western Ghats (Karnataka, Tamil Nadu)], Nepal, Bhutan, China, Japan (Long & Grolle, 1990; Piippo, 1990; So, 2001; Yamada & Iwatsuki, 2006; Rawat & Srivastava, 2007; Singh & Singh, 2007a).

**Plagiochila fruticosa** Mitt. in J. Proc. Linn. Soc. (Bot. 5): 94: 1861; M.L. So in Syst. Bot. Monog. 60: 66. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 96. 2007. *Plagiochila bipinnata* Steph., Sp. hepat. 6: 131. 1918.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Hongava Hill, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1300B).

*Distribution:* India [Western Himalaya (Uttarakhand); Eastern Himalaya (Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal); Western Ghats (Karnataka, Kerala, Tamil Nadu)], Nepal, Bhutan, China, Thailand, Japan, Philippines, Vietnam (Long & Grolle, 1990; Piippo, 1990; So, 2001; Yamada & Iwatsuki, 2006; Rawat & Srivastava, 2007; Lai & al., 2008).

**Plagiochila hattorii** Inoue in Bull. Nat. Sci. Mus. Tokyo Ser. B (Bot.) 2: 69. 1976; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 105. 2007.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c. 1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1524); West Imphal district, Jiribam, 05.03.1984, J. P. Ghosh 58019.

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya)], Japan (Rawat & Srivastava, 2007).

**Plagiochila nepalensis** Lindenb., Sp. hepat. (*Plagiochila* fasc. 2 – 4): 93. 1840; M.L. So in Syst. Bot. Monog. 60: 156. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 176. 2007. *Plagiochila brevifolia* Steph., Bull. Herb. Boissier (ser. 2), 3: 876. 1903. *Plagiochila cornuta* Steph., Bull. Herb. Boissier (ser. 2) 3: 874. 1903. *Plagiochila decolyana* Schiffn. ex Steph., Sp. hepat. 6: 144. 1918. *Plagiochila gammiana* Steph., Bull. Herb. Boissier (ser. 2), 3: 963. 1903. *Plagiochila gollanii* Steph., Bull. Herb. Boissier (ser. 2) 3: 883. 1903. *Plagiochila gollanii* var. *triquetra* Herzog in Ann. Bryol. 12: 76. 1939. *Plagiochila grata* Steph., Sp. hepat. 6: 160. 1918. *Plagiochila luethiana* Steph., Sp. hepat. 6: 180. 1921. *Plagiochila pseudorientalis* Inoue in J. Hattori Bot. 30: 126. 1967. *Plagiochila remotistipula* Steph., Sp. hepat. 6: 201. 1921. *Plagiochila semiaperta* Schiffn. ex Steph., Sp. hepat. 6: 210. 1921.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, 1881 – 1882, G. Watt 7504; Tamenglong district, 13.03.1984, J. P. Ghosh 58072.

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Karnataka, Kerala, Tamil Nadu), Punjab & Rajasthan plains (Punjab)], Nepal, Bhutan, China, Japan, Myanmar, Philippines, Indonesia, Thailand, Vietnam (Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Srivastava & Dixit, 1996; So, 2001; Zhu & So, 2001; Yamada & Iwatsuki, 2006; Rawat & Srivastava, 2007; Singh & Singh, 2007a, 2009; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Plagiochila parvifolia** Lindenb., Sp. hepat. (*Plagiochila* fasc. 1): 28. 1839; M.L. So in Syst. Bot. Monog. 60: 88. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 111. 2007.

*Plagiochila cuspidata* Steph., Sp. hepat. 6: 144. 1918. *Plagiochila neorupicola* Inoue in Bryologist 68: 218. 1965. *Plagiochila phalangea* Taylor in J. Bot. 5: 264. 1846. *Plagiochila subsymmetrica* Steph., Sp. hepat. 6: 212. 1921. *Plagiochila yokogurensis* Taylor, Bull. Herb. Boissier 5: 104. 1897.

*Specimen examined:* Terricolous and corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1303); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1304); Tengnoupal district, Lock-chou nala, 25.03.1984, J. P. Ghosh 58068, 58069.

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal)], Bhutan, China, Taiwan, Bangladesh, Sri Lanka, Indonesia, Philippines, Japan, Korea, Myanmar, Thailand, Vietnam, Papua New Guinea (Long & Grolle, 1990; Piippo, 1990; So, 2001; Yamada & Iwatsuki, 2006; Rawat & Srivastava, 2007; Singh & Singh, 2007a, 2009; Singh & Nath, 2007; Lai & al., 2008).

***Plagiochila perserrata*** Herzog in Handel-Mazzetti, Symb. Sin. 5: 19. 1903; M.L. So in Syst. Bot. Monog. 60: 48. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 83. 2007.

Vishnupur, U.S. Awasthi and A. Kumar 3871/79 (LWU) (fide Rawat & Srivastava, loc.cit.).

*Distribution:* India [Eastern Himalaya (Manipur)], Nepal, Bhutan, China, Indonesia (Hattori, 1975; Long & Grolle, 1990; Piippo, 1990; So, 2001; Rawat & Srivastava, 2007).

***Plagiochila sciophila*** Nees ex Lindenb., Sp. hepat. (*Plagiochila* fasc. 2 – 4: 100. 1840; M.L. So in Syst. Bot. Monog. 60: 112. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 116. 2007. *Plagiochila acanthophylla* Gottsche, Bot. Zeitung (Berlin) 16, Beil. 37, 38. 1858. *Plagiochila chiloscypchoidea* Steph., Sp. hepat. 2: 301. 1906. *Plagiochila flavovirens* Steph., Sp. hepat. 6: 156. 1918. *Plagiochila orientalis* Taylor in J. Bot. 5: 261. 1846. *Plagiochila trochantha* Schiffn. ex Steph., Sp. hepat. 6: 226. 1921. *Plagiochila vygensis* Steph., Sp. hepat. 5: 237. 1921.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c. 1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1307); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1308B, 1309); Ukhrul district, Sirohi Hill, c. 1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1310, 1311, 1312).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, Manipur – present study, Sikkim, West Bengal), Western Ghats (Kerala, Tamil Nadu), Andaman & Nicobar Islands (South Andaman)], Pakistan, Nepal, Bhutan, China, Japan, Korea, Philippines, Malaysia, Thailand, Vietnam, Indonesia, Papua New Guinea, Samoa, eastern North America, Australia (Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; So, 2001; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; McCarthy, 2006; Rawat & Srivastava, 2007; Singh & Singh, 2007a, 2009; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

***Plagiochila semidecurrens*** (Lehm. & Lindenb.) Lindenb., Sp. hepat. (*Plagiochila* fasc. 5): 142. 1843; M.L. So in Syst. Bot. Monog. 60: 51. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 71. 2007. *Jungermannia semidecurrens* Lehm. & Lindenb. in Lehmann, 4: 21. 1832. *Plagiochila aeqalis* Mitt. in J. Proc. Linn. Soc. (Bot. 5): 98. 1861. *Plagiochila asymmetrica* Steph., Sp. hepat. 6: 125. 1917. *Plagiochila grossevitta* Steph., Spec. hepat. 6: 161. 1918. *Plagiochila inermis* Schiffn. ex Steph., Sp. hepat. 6: 169. 1918. *Plagiochila kamaounensis* Taylor in J. Bot. 5: 262. 1846. *Plagiochila longicalyx* Steph. in Bull. Herb. Boissier (ser. 2) 3: 532. 1903. *Plagiochila nidulans* Herzog in Ann. Bryol. 5: 73. 1932. *Plagiochila nilgherriensis* Steph., Spec. hepat. 6: 189. 1921. *Plagiochila renitens* (Nees) Lindenb., Spec. Hepat. (fasc. 2 – 4): 90. 1840. *Plagiochila schaulina* Schiffn. ex Steph., Sp. hepat. 6: 210. 1921. *Plagiochila semidecurrens* (Lehm. & Lindenb.) Lindenb. var. *undulata* Carl. in Ann. Bryol., Suppl. 2: 98. 1931.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c. 1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1254B).

*Distribution:* India [Eastern Himalaya (Assam, Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, China, Thailand, Indonesia, Korea, Japan, Papua New Guinea, (Long & Grolle, 1990; Piippo,

1990; So, 2001; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Rawat & Srivastava, 2007; Lai & al., 2008).

**Plagiochila subtropica** Steph. in Bull. Soc. Roy. Bot. Belgique (1899) 38, Mem. 46. 1900; M.L. So in Syst. Bot. Monog. 60: 93. 2001; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 107. 2007. *Plagiochila deterrmii* Steph. in Bull. Herb. Boissier (ser. 2) 3: 876. 1903. *Plagiochila diffracta* Herzog in Mem. Soc. Fauna Fl. Fenn. 26: 25. 1949 – 1950. *Plagiochila kitagawae* Inoue in J. Hattori Bot Lab. 38: 560. 1974.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c. 1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1313).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Kerala, Tamil Nadu)], Nepal, Bhutan, China, Thailand (Piippo, 1990; So, 2001; Rawat & Srivastava, 2007; Singh & Nath, 2007; Lai & al., 2008).

**Plagiochila uniformis** Mitt. in J. Proc. Linn. Soc., Bot. 5: 98. 1861; K.K. Rawat & S.C. Srivast., Genus *Plagiochila* in Eastern Himalaya (India), 195. 2007. *Plagiochila ambigua* Mitt. in J. Proc. Linn. Soc., Bot. 5: 98. 1861. *Plagiochila mittenii* Steph. in Bull. Herb. Boissier 5: 83. 1897. *Plagiochila simlana* Mitt. ex Steph. in Bull. Herb. Boissier (ser. 2) 3: 525. 1903.

Manipur, G. Watt, s.n. (NY) (fide Rawat & Srivastava, loc. cit.).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya, West Bengal)], Pakistan, Nepal, Bhutan, Thailand (Mitten, 1861; Long & Grolle, 1990; So & Grolle, 2000; Rawat & Srivastava, 2007; Lai & al., 2008; Singh & Singh, 2009).

#### RADULACEAE

**Radula acuminata** Steph., Sp. hepat. 4: 230. 1910; Udar & Dh. Kumar in Geophytology 14: 162. 1984; R.L. Zhu & M.L. So in Nova Hedwigia 121: 60. 2001. *Radula yunnanensis* P.C. Chen in Feddes Rept. 58: 39. 1955. *Radula acuminata* Steph. fo. *corticola* S. Hatt. in Bull. Tokyo Sci. Mus. 11: 81. 1944.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1314, 1315); West Mountain, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1316).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim)], Nepal, China, Sri Lanka, Japan, Indonesia, Malaysia, Philippines, Fiji, Papua New Guinea, Thailand, Vietnam, Cambodia (Yamada, 1979; Onraedt, 1981; Udar & Kumar, 1984a; Tan & Engel, 1986; Piippo, 1990; Singh, 1996; Zhu & So, 2001; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008; Dey & al., 2009).

**Radula lindbergiana** Gottsche ex Hartm., Handb. Skand. Fl. 9: 98. 1864; Udar & Dh. Kumar in Biol. Mem. 9: 76. 1984; Sushil K. Singh & D.K. Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 155. 2009.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c. 1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1317); Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1318); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1319).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand), Eastern Himalaya (Manipur – present study, Sikkim, West Bengal), Western Ghat (Tamil Nadu)], Nepal, China, Korea, Iran, CIS, Macronesia, Europe, Africa, North America (Schuster, 1980; Udar & Kumar, 1984b; Piippo, 1990; Paton, 1999; Singh & Singh, 2009).

**Radula tjibodensis** K.I. Goebel in Ann. Jard. Bot. Buitenzorg 7: 53. 1888; Yamada in J. Hattori Bot. Lab. 45: 294. 1979; Udar & Dh. Kumar in Geophytology 14: 168. 1984. *Radula flavescens* Steph., Sp. hepat. 4: 203. 1910. *Radula reineckeana* Steph., Sp. hepat. 4: 225. 1910. *Radula tayabensis* Steph., Sp. hepat. 6: 516. 1924.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1320).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Sri Lanka, China, Fiji, Indonesia, Malaysia, Thailand, Philippines, Samoa, Vietnam, New Caledonia, Papua New Guinea (Yamada, 1979; Onraedt, 1981; Udar & Kumar, 1984a; Tan & Engel, 1986; Zhu & So, 2001; Lal, 2003; Singh & al., 2008a; Lai & al., 2008).

#### PORELLACEAE

**Porella campylophylla** (Lehm. & Lindenb.) Trevis. in Mem. Reale. Ist. Lombardo Sci. Ser. 3, 4: 408. 1877; F. Shaheen & S.C. Srivast. in Geophytology 19: 34. 1989. *Jungermannia campylophylla* Lehm. & Lindenb. in Nov. Strip. pug. 6: 40. 1834. *Madotheca campylophylla* (Lehm. & Lindenb.) Gottsche, in Gottsche & al., Syn. hepat. 265. 1845. *Madotheca ptychantha* Mitt. in J. Proc. Linn. Soc., Bot. 5: 108. 1861. var. **campylophylla**

*Specimen examined:* Terricolous, corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1321, 1322, 1223, 1324, 1325, 1326).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghat (Tamil Nadu)], Nepal, Bhutan, China, Thailand, Myanmar, Vietnam (Hattori, 1966; Shaheen & Srivastava, 1989; Piippo, 1990; Long & Grolle, 1990; Singh, 1996; Lai & al., 2008; Singh & Singh, 2009).

**Porella campylophylla** (Lehm. & Lindenb.) Trevis. var. **ligulifera** (Taylor) S. Hatt. in J. Hattori Bot. Lab. 32: 333. 1969; F. Shaheen & S.C. Srivast. in Geophytology 19: 36. 1989. *Madotheca ligulifera* Taylor in Lehm., Nov. strip. pug. 8: 10. 1844.

*Specimen examined:* Terricolous and corticolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1327); Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1328); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1329, 1330, 1331); Khangkhui forest, 26.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1332, 1333, 1334); Ukhrul district, Makuikhang forest, c.2400 m, 21.03.1984, J. P. Ghosh 58063.

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim), Nepal, China, Thailand (Hattori, 1966; Shaheen & Srivastava, 1989; Piippo, 1990; Singh & Nath, 2007; Singh & al., 2008a; Lai & al., 2008).

**Porella madagascariensis** (Nees & Mont.) Trevis. in Mem. Reale. Ist. Lombardo Sci. Ser. 3, 4: 407. 1877. *Lejeunea madagascariensis* Nees & Mont., Ann. Sci. Nat. Ser. 2, 5: 6. 1836. *Madotheca nilgheriensis* Mont. in Ann. Sci. Nat. Bot. 17: 15. 1842.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1335).

*Distribution:* India [Western Himalaya (Jammu & Kashmir, Himachal Pradesh), Eastern Himalaya (Manipur – present study), Western Ghats (Tamil Nadu)], Sri Lanka, China, Africa (Mitten, 1861; Onraedt, 1981; Piippo, 1990; Singh & Singh, 2009).

**Porella perrottetiana** (Mont.) Trevis. in Mem. Reale. Ist. Lombardo Sci. Ser. 3, 4: 408. 1877; Udar & F. Shaheen in J. Indian Bot. Soc. 62: 319. 1983. *Madotheca perrottetiana* Mont. in Ann. Sci. Bot. Ser. 2, 17: 15. 1843.

*Specimen examined:* Terricolous and corticolous. India: Eastern Himalaya, Manipur, Khamelock Hill, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1337, 1338); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1339, 1340); Ukhrul district, Makuikhang forest, c.2400 m, 24.03.1984, J. P. Ghosh 58065.

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Manipur – present study, West Bengal), Western Ghats (Tamil Nadu)], Sri Lanka, Nepal, Bhutan, China, Myanmar, Japan, Philippines (Onraedt, 1981; Udar & Shaheen, 1983a; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Yamada & Iwatsuki, 2006).

**Porella plumosa** (Mitt.) Inoue in Bull. Natl. Sci. Mus. Tokyo 9: 385. 1966; Udar & F.Shaheen in Misc. Bryol. Lichenol. 9: 196. 1983. *Madotheca plumosa* Mitt. in J. Proc. Linn. Soc., Bot. 5: 108. 1861. var. **plumosa**

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1341, 1523B).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya), Western Ghats (Tamil Nadu)], Pakistan, Nepal, China, Myanmar, Philippines, Thailand, Vietnam (Udar & Shaheen, 1983b; Tan & Engel, 1986; Piippo, 1990; Singh, 1996; Lai & al., 2008; Singh & Singh, 2009).

#### JUBULACEAE

**Frullania acutiloba** Mitt. J. Proc. Linn. Soc., Bot. 5: 120. 1861; V.Nath & A.K.Asthana in J. Hattori. Bot. Lab. 85: 72. 1998.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1342, 1343).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya), Western Ghats (Tamil Nadu)], Sri Lanka, China, Indonesia (Hattori, 1973; Onraedt, 1981; Piippo, 1990; Nath & Asthana, 1998; Singh & al., 2008b).

**Frullania arecae** (Spreng.) Gottsche, Mex. Leverm. 236. 1863; Yuzawa in J. Hattori Bot. Lab. 70. 264. 1991. *Jungermannia arecae* Spreng. in Neue Entdeck. Pflanzenk. 2: 99. 1821. *Frullania wallichiana* Mitt. in J. Proc. Linn. Soc., Bot. 5: 118. 1861. var. **arecae**

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Khangkhui forest, 26.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1344).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Nepal, Bhutan, China, Thailand, Pacific Island, Australia, Africa, North America (Mitten, 1861; Chopra, 1943; Hattori, 1966; Hattori & Thaithong, 1978a; Piippo, 1990; Long & Grolle, 1990; Yuzawa, 1991; Grolle, 1995; Wigginton & Grolle, 1996; Singh & Nath, 2007; Singh & al., 2008a; Singh & al., 2008b; Verma & Srivastava, 2008; Lai & al., 2008).

**Frullania ericoides** (Nees) Mont. in Ann. Sci. Nat. Bot. (ser. 2) 12: 51. 1839; Sim-Sim in Cryptogamie. Bryol. 20: 128. 1999; A.P.Singh & al. in Taiwania 53: 62. 2008. *Jungermannia ericoides* Nees in Mastius Fl. Brasil. 1: 346. 1833. *Frullania rotundiloba* Steph., Sp. hepat. 4: 679. 1911. *Frullania squarrosa* (Reinw. & al.) Dumort., Recueil observ. Jungerm. 13. 1835.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1345, 1346, 1347).

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Kerala)], Nepal, Bhutan, Sri Lanka, China, Thailand, Korea, Japan, Pacific Island, Australia, Africa, (Mitten, 1861; Chopra, 1943; Hattori, 1971; Hattori & Thaithong, 1978a; Long, 1979; Onraedt, 1981; Long & Grolle, 1990; Piippo, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Nair & al., 2005; McCarthy, 2006; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a; Singh & al., 2008b; Verma & Srivastava, 2008; Lai & al., 2008).

**Frullania muscicola** Steph. in Hedwigia 33: 146; A.P.Singh & al. in Taiwania 53: 70. 2008; Sushil K.Singh & D.K.Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 212. 2009.

*Specimen examined:* Terricolous, and corticolous. India: Eastern Himalaya, Manipur, Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1348); 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1525); Tadubi forest, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1349A); Ukhrul district, Ukhrul, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1350, 1351); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1352, 1353, 1354).



*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim), Central India (Madhya Pradesh), Western Ghats (Tamil Nadu)], Nepal, China, Thailand, Korea, Japan, C.I.S (Hattori, 1966, 1975; Piippo, 1990; Singh, 1996; Nath & Asthana, 1998; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & al., 2008b; Lai & al., 2008; Singh & Singh, 2009).

**Frullania nepalensis** (Spreng.) Lehm. & Lindenb., 4: 19. 1832; S.Hatt. in Hara, Flora of Eastern Himalaya 526. 1966; A.P.Singh & al. in Taiwania 53: 63. 2008. *Jungermannia nepalensis* Spreng. in Syst. Veget. 4: 324. 1827. *Frullania grevilleana* Taylor in Gottsche & al., Syn. hepat. 421. 1845. *Frullania laxipinnata* Steph., Sp. hepat. 4: 457. 1910.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1355, 1356A, 1357A); Ukhrul district, Ukhrul, c.1850 m, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1358A); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1254C, 1359, 1360).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, China, Thailand, Korea, Japan (Hattori & Thaithong, 1978a; Long, 1979; Long & Grolle, 1990; Piippo, 1990; Yuzawa & Koike, 1994; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a; Singh & al., 2008b; Lai & al., 2008).

**Frullania physantha** Mitt. in J. Proc. Linn. Soc., Bot. 5: 121. 1861; V.Nath & Udar in Proc. Indian natn. Sci. Acad. B50 (2): 229. 1984; A.P.Singh & al. in Taiwania 53: 73. 2008.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Tadubi forest, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1361); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1362A); Keibul, 02.03.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1363).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, China, North Vietnam (Hattori & Thaithong, 1978a; Piippo, 1990; Yuzawa & Koike, 1994; Singh, 1996; Singh & Nath, 2007; Singh & al., 2008a, 2008b).

**Frullania tamarisci** (L.) Dumort., Recueil observ. Jungerm. 13. 1835; A.P.Singh & al. in Taiwania 53: 60. 2008. *Jungermannia tamarisci* L., Sp. pl. 2: 1134. 1753. subsp. **tamarisci**

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1364).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, West Bengal), Western Ghats (Kerala, Tamil Nadu)], China, Sri Lanka, Malaysia, Thailand, Korea, Japan, Europe, Africa (Hattori, 1966; Onraedt, 1981; Piippo, 1990; Schuster, 1992; Wigginton & Grolle, 1996; Nath & Asthana, 1998; Nair & al., 2005; Singh & al., 2008b; Lai & al., 2008; Dey & al., 2009).

**Frullania tuyamae** S.Hatt. & Thaithong in J. Jap. Bot. 53: 175. 1978; J.Lal in Bull. Bot. Surv. India 21: 81. 1979.

Ukhrul, 1876 m, J. Lal & B.D. Kar 97 (CAL) (fide Lal, loc.cit.).

*Distribution:* India [Eastern Himalaya (Manipur)], Laos (Hattori & Thaithong, 1978b; Lal, 1979a).

**Jubula pennsylvanica** (Steph.) A.Evans in Rhodora 7: 55. 1905; W.R.Guerke in Bryophyt. Biblioth. 17: 79. 1978; R.M.Schust., Hepat. & Anthocerot. of North America 5: 275. 1992. *Frullania pennsylvanica* Steph. in Hedwigia 22: 147. 1883. subsp. **pennsylvanica**

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1461B); Hongava Hill, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1300A).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Sikkim)], North America (Guerke, 1978; Schuster, 1992; Dey & al., unpubl.).

## LEJEUNEACEAE

**Cheilolejeunea girdaldiana** (C.Massal.) Mizut. in J. Hattori Bot. Lab. 27: 141. 1964; S.Hatt. in Hara, Flora of Eastern Himalaya 529. 1966; G.Asthana & al. in Lindbergia 20: 139. 1995 “1996”. *Euosmolejeunea girdaldiana* C.Massal. in Mem. Accad. Agric. Verona 37: 34. 1897.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Khamelock Hill, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1365).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal China, Philippines, Japan (Hattori, 1966; Mizutani, 1982; Tan & Engel, 1986; Asthana & al., 1995; Singh & Nath, 2007).

**Cheilolejeunea trapezia** (Nees) Kachroo & R.M.Schust. in J. Linn. Soc. London, Bot. 56: 509. 1961. *Jungermannia trapezia* Nees, Enum. Pl. Crypt. Jav.: 41. 1830. *Cheilolejeunea imbricata* (Nees) S.Hatt. in Misc. Bryol. Lichenol. 1: 1. 1957; Asthana & al. in Lindbergia 20: 137. 1995 “1996”.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Liton, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1366).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Bhutan, Nepal, Sri Lanka, China, Thailand, Philippines, Indonesia, Japan, Korea, Samoa, New Guinea, Australia (Onraedt, 1981; Piippo, 1990; Long & Grolle, 1990; Asthana & al., 1995; Zhu & Long, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a; Verma & Srivastava, 2008; Dey & al., 2009).

**Cololejeunea haskarliana** (Lehm. & Lindenb.) Schiffn., Consp. Hepat. Arch. Ind. 244. 1898; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 321. 2001; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 60. 2003. *Lejeunea haskarliana* Lehm. & Lindenb. in Lehm., Nov. strip. pug. 8: 26. 1844. *Lejeunea venusta* Sande Lac., Syn. Hep. Jav. 64. 1856. *Leptocolea hispidissima* Steph. in Leaf. Philipp. Bot. 6: 2287. 1914.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1367).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study), Western Ghats (Karnataka, Tamil Nadu)], Bhutan, Sri Lanka, China, Indonesia, Japan, Malaysia, Cambodia, New Caledonia, Philippines, Vietnam, Africa (Pandé & Misra, 1943; Onraedt, 1981; Tixier, 1985; Mizutani, 1986; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Grolle, 1995; Zhu, 1995; Zhu & So, 2001; Asthana & Srivastava, 2003; Yamada & Iwatsuki, 2006; Dey & al., 2009).

**Cololejeunea lanciloba** Steph. in Hedwigia 34: 250.1895. *Leptocolea lanciloba* (Steph.) A.Evans in Bull. Torrey Bot. Club 38: 268. 1911.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1368A, 1369A, 1370, 1371C, 1372, 1373, 1374, 1375, 1376, 1377, 1378, 1379); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1380, 1381, 1382).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya), Andaman & Nicobar Islands (Nicobar)], Bangladesh, Sri Lanka, China, Indonesia, Japan, Malaysia, Cambodia, New Caledonia, Polynesia, Philippines, Thailand, Hawaii, Australia, Africa (Mizutani, 1961, 1975, 1984a; Onraedt, 1981; Tixier, 1985; Tan & Engel, 1986; Piippo, 1990; Zhu & So, 2001; Asthana & Srivastava, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Cololejeunea latilobula** (Herzog) Tixier in Bryophyt. Biblioth. 27: 156. 1985; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 36. 2003. *Leptocolea latilobula* Herzog in Handel-Mazzetti, Symb. Sin. 5: 54. 1930. *Leptocolea himalayensis* Pandé & Misra in Proc. Nat. Acad. Sci. 13: 28. 1943. *Cololejeunea himalayensis* (Pandé & Misra) R.M.Schust. in Beih. Nova Hedwigia 9: 177. 1963.

*Specimen examined:* Corticolous and foliicolous. India: Eastern Himalaya, Manipur, Senapati district, Tadubi forest, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1349B); Ukhrul district, Tushen, 21.02.1978, J.

Lal & B. D. Kar, s.n. (acc. no. 1383A, 1384, 1385, 1386, 1387, 1388, 1389, 1390B, 1391B, 1392); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1526C).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Sikkim, West Bengal, Manipur, Meghalaya), Western Himalaya (Uttarakhand), Western Ghats (Karnataka, Kerala, Tamil Nadu), Central India (Madhya Pradesh)], China, Myanmar, Vietnam, Africa (Piippo, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Zhu & So, 2001; Asthana & Srivastava, 2003; Singh & al., 2008a; Dey & al., 2009).

**Cololejeunea longifolia** (Mitt.) Benedix ex Mizut. in J. Hattori Bot. Lab. 26: 184. 1963; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 308. 2001; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 52. 2003. *Lejeunea longifolia* Mitt. in J. Proc. Linn. Soc., Bot. 5: 117. 1861. *Physocolea longifolia* (Mitt.) Steph., Sp. hepat. 5: 898. 1916. *Lejeunea diversifolia* Mitt. in J. Proc. Linn. Soc., Bot. 5: 118. 1861. *Physocolea diversifolia* (Mitt.) Steph., Sp. hepat. 5: 892. 1916.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1369B, 1393, 1394, 1371A, 1395, 1396, 1391C); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1397B).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal), Andaman & Nicobar Islands (Andaman Islands)], Nepal, Bhutan, Bangladesh, Sri Lanka, China, Japan, Korea, Malaysia, New Guinea, Philippines, Thailand, New Caledonia (Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Zhu & So, 2001; Asthana & Srivastava, 2003; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; Lai & al., 2008; Dey & al., 2009).

**Cololejeunea planissima** (Mitt.) Abeyw. in Ceylon J. Sci., Bio. Sci. 2: 73. 1959; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 279. 2001; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 42. 2003. *Lejeunea planissima* Mitt. in J. Proc. Linn. Soc., Bot. 5: 117. 1861. *Physocolea trianguliloba* Steph., Sp. hepat. 5: 907. 1916.

Kanchipur, c.1000 m, A. Kumar & U.S. Awasthi 3593/79, 3594/79 (LWU) (fide Asthana & Srivastava, loc.cit.).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Bhutan, Sri Lanka, China, Thailand, Japan, Korea, Indonesia, Malaysia, Micronesia, Vietnam, Cambodia, Laos, Africa, (Onraedt, 1981; Mizutani, 1984a; Piippo, 1990; Zhu & So, 2001; Asthana & Srivastava, 2003; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Cololejeunea pseudofloccosa** (Horik.) Benedix in Feddes Repert. Beih. 134: 36. 1953; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 70. 2003. *Leptocolea pseudofloccosa* Horik. in J. Sci. Hiroshima Univ., Ser.B, Div. 2, Bot. 1: 87. 1932. *Taeniolejeunea pseudofloccosa* (Horik.) S.Hatt. in J. Jap. Bot. 17: 465. 1941.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1391A).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Bhutan, Nepal, Sri Lanka, China, Japan, Indonesia, Malaysia, Philippines, Vietnam, Cambodia, Laos, Australia (Onraedt, 1981; Mizutani, 1984b; Tan & Engel, 1986; Piippo, 1990; Zhu, 1995; Zhu & So, 2001; Asthana & Srivastava, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Singh & Nath, 2007).

**Cololejeunea trichomanis** (Gottsche) Steph. in Hedwigia 34: 252. 1895; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 54. 2003. *Lejeunea trichomanis* Gottsche in Abh. Naturw. Ver. Bremen 7: 362. 1882. *Physocolea trichomanis* (Gottsche) Steph., Sp. hepat. 5: 912. 1916. *Lejeunea goebelii* Gottsche in Goebel, Ann. Jard. Bot. Buitenzorg 7: 49. 1887. *Cololejeunea goebelii* (Gottsche ex Schiffn.) Schiffn. in Bot. Jahrb. Syst. 23: 581. 1897. *Cololejeunea pandei* Udar & G.Srivast. in J. Bryol. 12: 227. 1982.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1391C).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Sikkim, West Bengal), Western Ghats (Karnataka)], Nepal, China, Japan, Korea, Indonesia, Malaysia, Philippines, Vietnam, Thailand, Cambodia, Laos, Australia (Tan & Engel, 1986; Piippo, 1990; Zhu & So, 2001; Asthana & Srivastava, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Lai & al., 2008; Dey & al., 2009).

**Cololejeunea udarii** G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 40. 2003.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1369C, 1398, 1399, 1400).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study), Western Ghats (Karnataka, Tamil Nadu)] (Asthana & Srivastava, 2003).

**Drepanolejeunea erecta** (Steph.) Mizut. in J. Hattori Bot. Lab. 40: 442. 1976; Udar & U.S.Awasthi in J. Hattori Bot. Lab. 53: 422. 1982; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 183. 2001. *Leptolejeunea erecta* Steph. in Bull. Soc. Roy. Bot. Belgique 38: 44. 1899. *Drepanolejeunea japonica* Horik. in J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot. 1: 202. 1933. *Drepanolejeunea monophthalma* (Herzog) Mizut. in J. Hattori Bot. Lab. 29: 291. 1966. *Strepsilejeunea monophthalma* Herzog in Handel-Mazzetti, Symb. Sin. 5: 47. 1930. *Harpalejeunea monophthalma* (Herzog) R.M.Schust. in Beih. Nova Hedwigia 9: 113. 1963. *Strepsilejeunea denticulata* Kamim., Contr. Fl. Hepat. Shikoku. 115. 1952.

*Specimen examined:* Corticolous and foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1397C); Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1401).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Bhutan, Nepal, China, Japan, Laos, Vietnam (Udar & Awasthi, 1982a; Long & Grolle, 1990; Piippo, 1990; Zhu & So, 2001; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a; Dey & al., 2009).

**Drepanolejeunea herzogii** R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 181. 2001. *Strepsilejeunea ocellata* Herzog in Memoranda Soc. Fauna Fl. Fenn. 26: 57. 1950.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1402, 1403A).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal)], Nepal, China (Herzog, 1950; Zhu & So, 2001; Zhu & Long, 2003; Dey & al., 2009).

**Drepanolejeunea yunnanensis** (P.C.Chen) Grolle & R.L.Zhu in Nova Hedwigia 70: 388. 2000. *Rhaphidolejeunea yunnanensis* P.C.Chen in Feddes Repert. 58: 44. 1955. *Leptolejeunea yunnanensis* (P.C.Chen) R.M.Schust. in Beih. Nova Hedwigia 9: 115. 1963.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1403B, 1404, 1405, 1406A).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, West Bengal), Western Ghats (Karnataka)], China, Japan (Udar & Awasthi, 1984; Singh, 1996; Grolle & Zhu, 2000; Zhu & So, 2001).

**Lejeunea alata** Gottsche in Gottsche, Lindenb. & Nees, Syn. hepat. 406. 1845; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 137. 2001; M.Dey & D.K.Singh in Geophytology 37: 43. 2008.

*Specimen examined:* Corticolous and Terricolous. India: Eastern Himalaya, Manipur, Tadubi forest, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1407A); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1408).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal)], China, Indonesia, Malaysia, Papua New Guinea, Polynesia, Samoa, Vietnam, Africa (Mizutani, 1970; Pócs & al., 1994; Grolle, 1995; Wigginton & Grolle, 1996; Zhu & So, 2001; Dey & Singh, 2008; Dey & al., 2009).

**Lejeunea anisophylla** Mont. in Ann. Sci. Nat., Bot., Sér. 2. 19: 263. 1843; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 156. 2001. *Lejeunea boninensis* Horik. in J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot. 1: 24. 1931. *Lejeunea borneensis* Steph., Sp. hepat. 5: 769. 1915. *Microlejeunea catanduana* Steph. in Hedwigia 35: 113. 1896. *Rectolejeunea obliqua* Herzog in J. Hattori Bot. Lab. 14: 49. 1955.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Khamelock Hill, 18.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1409).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim)], Sri Lanka, China, Japan, Indonesia, Malaysia, Thailand, Micronesia, Hawaii, Papua New Guinea, New Caledonia, Philippines, Tahiti, Tonga, Samoa, Vietnam, Australia (Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Yamada & Iwatsuki, 2006; Zhu & So, 2001; Singh & Nath, 2007; Lai & al., 2008; Dey & al., 2009).

**Lejeunea flava** (Sw.) Nees, Naturgesch. Eur. Leberm. 3: 277. 1838; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 143. 2001; Sushil K. Singh & D.K. Singh in Geophytology 32: 115. 2004. *Jungermannia flava* Sw., Prodr. 144. 1788. *Taxilejeunea crassiretis* Herzog in Handel-Mazetti, Symb. Sin. 5: 51. 1930.

*Specimen examined:* Corticolous and foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1369D, 1383B, 1390A); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1526B).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh), Western Ghats (Karnataka, Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Indonesia, Thailand, Philippines, Japan, Korea, New Zealand, Jamaica, North & South America, Europe, Africa, Australia (Mizutani, 1971; Schuster, 1980; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Singh & Singh, 2004; McCarthy, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Lejeunea neelgherriana** Gottsche in Gottsche & al., Syn. hepat. 354. 1845; R.L.Zhu & M.L.So in Ann. Bot. Fenn. 37: 149. 2000.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1410, 1523C).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Sikkim, West Bengal), Western Ghats (Tamil nadu)], Nepal, Bhutan, Sri Lanka, China, Japan, Korea (Yamada & Iwatsuki, 2006; Zhu & So, 2000).

**Lejeunea obscura** Mitt. in J. Proc. Linn. Soc., Bot. 5: 112. 1861; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 139. 2001. *Hygrolejeunea obscura* (Mitt.) Steph., Sp. hepat. 5: 565. 1914. *Taxilejeunea obscura* (Mitt.) Eifrig in Ann. Bryol. 9: 93. 1937 “1936”.

*Specimen examined:* Terricolous, corticolous and foliicolous. India: Eastern Himalaya, Manipur, on way to Kangpoki forest, 15.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1411); Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1371B, 1412, 1413); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1371B); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1414, 1415); Hongava forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1416); Churachandpur district, Churachandpur, c.831 m, 01.03.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1417).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, Sri Lanka, China, Indonesia (Mitten, 1861; Onraedt, 1981; Zhu & So, 2001; Zhu & Long, 2003; Singh & al., 2008a; Dey & al., 2009).

**Lejeunea princeps** (Steph.) Mizut. in J. Hattori Bot. Lab. 34: 454. 1971. *Hygrolejeunea princeps* Steph., Sp. hepat. 5: 568. 1914. *Lejeunea flexuosa* Mitt. in J. Proc. Linn. Soc., Bot. 5: 114. 1861.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1418); Khangkui forest, 26.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1419).

*Distribution:* India [Eastern Himalaya (Assam, Manipur – present study, Sikkim, West Bengal)], Nepal (Mitten, 1861; Mizutani, 1963, 1971; Singh & Nath, 2007; Singh & al., 2008a).

**Lejeunea punctiformis** Taylor in London J. Bot. 5: 398. 1846; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 128. 2001. *Microlejeunea punctiformis* (Taylor) Steph. in Hedwigia 29: 90. 1890.

*Specimen examined:* Terricolous and corticolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1420, 1421); Khamelock Hill, 18.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1422).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Japan, Thailand, Vietnam, Australia (Mizutani, 1961; Long & Grolle, 1990; Zhu & So, 2001; Zhu & Long, 2003; McCarthy, 2006; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Lejeunea tuberculosa** Steph., Sp. hepat. 5: 790. 1915; Mizut. in J. Hattori Bot. Lab. 34: 451. 1971; R.L.Zhu & M.L.So in Beih. Nova Hedwigia 121: 152. 2001.

*Specimen examined:* Terricolous, corticolous and foliicolous. India: Eastern Himalaya, Manipur, Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1423), Tadubi forest, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1424); Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1425, 1426); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1368B); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1427).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Uttarakhand), Western Ghats (Kerala, Tamil Nadu)], Nepal, Bhutan, China, Indonesia, Philippines, Thailand, Africa (Mizutani, 1971; Tan & Engel, 1986; Long & Grolle, 1990; So & Zhu, 1998; Zhu & So, 1999, 2001; Nair & al., 2005; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Leptolejeunea balansae** Steph. in Hedwigia 35: 105. 1896; U.S.Awasthi in J. Indian bot. Soc. 65: 119. 1986; R.L. Zhu & M.L. So in Beih. Nova Hedwigia 121: 209. 2001.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1406B).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal), Western Ghats (Tamil Nadu), Andaman & Nicobar Islands (Andaman Islands)], Cambodia, China, Indonesia, Laos, Malaysia, Thailand, Vietnam (Awasthi, 1986; Piippo, 1990; Zhu & So, 2001; Daniels & Daniel, 2004; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Leptolejeunea elliptica** (Lehm. & Lindenb.) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 126. 1893; R.L. Zhu & M.L. So in Beih. Nova Hedwigia 121: 209. 2001. *Jungermannia elliptica* Lehm. & Lindenb., Nov. strip. pug. 5: 13. 1833. *Leptolejeunea subacuta* Steph. ex A. Evans in Proc. Wash. Acad. Arts Sci. 8: 149. 1906.

*Specimen examined:* Foliicolous. India: Eastern Himalaya, Manipur, Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1428).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Karnataka, Tamil Nadu), Andaman & Nicobar Islands (Andaman Islands)], Nepal, Bhutan, Sri Lanka, China, Japan, Indonesia, Philippines, Thailand, Molucca, Australia, Africa, North America (Onraedt, 1981; Awasthi, 1986; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Grolle, 1995; Singh, 1996; Zhu & So, 2001; Lal, 2003; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & al., 2008a; Lai & al., 2008; Dey & al., 2009).

**Lopholejeunea nigricans** (Lindenb.) Schiffn. in Consp. Hepat. Arch. Ind. 293. 1898; R.L.Zhu & Gradst. in Syst. Bot. Monog. 74: 44. 2005. *Lejeunea nigricans* Lindenb. in Gottsche & al., Syn. hepat. 316. 1845. *Lopholejeunea javanica* (Nees) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1893. *Lopholejeunea abortiva* (Mitt.) Steph., Sp. hepat. 5: 70. 1912. *Lopholejeunea sikkimensis* Steph., Sp. hepat. 5: 87. 1912. *Lopholejeunea abortiva* var. *doliiformis* U.S.Awasthi & al. in Geophytology

29: 41. 2000 ("1999"). *Lopholejeunea kashyapii* U.S.Awasthi & al. in Geophytology 29: 48. 2000 ("1999"). *Lopholejeunea sikkimensis* var. *dentata* U.S.Awasthi & al. in Geophytology 29: 56. 2000 ("1999").

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1429).

*Distribution:* India [Wester Himalaya (Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal), Central india (Madhya Pradesh), Western Ghats (Karnataka, Kerala, Tamil Nadu)], Bangladesh, Bhutan, Nepal, China, Japan, Indonesia, Malaysia, Myanmar, Philippines, Papua New Guinea, Thailand, Vietnam, Yemen, Cambodia, Fiji, New Caledonia, Samoa, Tahiti, Africa, North, Central & South America, Australia (Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Awasthi & al. 2000; Zhu & Gradstein, 2005; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & al., 2008a; Lai & al., 2008).

**Mastigolejeunea auriculata** (Wilson) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1895. *Jungermannia auriculata* Wilson in Drumm., Musci Amer. Exsic. no. 170. 1841. *Mastigolejeunea humilis* (Gottsche) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1895.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Ukhrul district, Liton, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1430); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1431B, 1432B).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya), Western Ghats (Kerala), Andaman & Nicobar Islands (Andaman Islands)], Nepal, Bhutan, Sri Lanka, Indonesia, Philippines, Thailand, Japan, Australia (Onraedt, 1981; Awasthi & Udar, 1984; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Joshi, 2001; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & Nath, 2007; Lai & al., 2008).

**Ptychanthus striatus** (Lehm. & Lindenb.) Nees in Naturgesch. eur. Leberm. 3: 212. 1838; U.S.Awasthi & S.C.Srivast. in Geophytology 17: 12. 1987. *Jungermannia striata* Lehm. & Lindenb. in Lehm., Nov. stirp. pug. 4: 16. 1832. *Ptychanthus argutus* Steph., Sp. hepat. 4: 742. 1912. *Ptychanthus effusus* Steph., Sp. hepat. 4: 746. 1912. *Ptychanthus perrotteti* Steph., Sp. hepat. 4: 750. 1912. *Ptychanthus pyriformis* Steph., Sp. hepat. 4: 751. 1912. *Ptycholejeunea pyriformis* Steph. in Hedwigia 35: 122. 1896. *Brachiolejeunea andamana* Steph., Sp. hepat. 5: 130. 1912.

*Specimen examined:* Terricolous and corticolous. India: Eastern Himalaya, Manipur, Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1433, 1434); Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1435, 1449, 1450); Ukhrul district, Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1264B); Ukhrul district, Sirohi Hill, c.1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1442, 1443); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1440B, 1441, 1444, 1445, 1446, 1447); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1356B, 1357B, 1358B, 1447, 1448); Khangkhui forest, 26.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1437); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1438, 1439); Tamenglong district, K.T. Road, 09.03.1984, J.P. Ghosh 58036; Ukhrul, 20.03.1984, J.P. Ghosh 58061.

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Central India (Madhya Pradesh), Western Ghats (Maharashtra, Karnataka, Kerala, Tamil Nadu), Andaman & Nicobar Islands], Bhutan, Nepal, Sri Lanka, China, Myanmar, Philippines, Indonesia, Japan, Malaysia, Thailand, Samoa, New Guinea, New Zealand, Australia, Africa (Onraedt, 1981; Tan & Engel, 1986; Awasthi & Srivastava, 1987; Piippo, 1990; Long & Grolle, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Singh, 1996; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & Singh, 2007b; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh & al., 2008a; Lai & al., 2008).

**Spruceanthus semirepandus** (Nees) Verd. in Ann. Bryol. Suppl. 4: 153. 1934; Udar & U.S.Awasthi in J. Indian Bot. Soc. 61: 184. 1982. *Jungermannia semirepanda* Nees, Hepat. Jav. 39. 1830.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1451).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), Central India (Madhya Pradesh), Western Ghats (Kerala, Tamil Nadu), Sri Lanka, Nepal, Bhutan, China, Philippines, Indonesia, Thailand, Japan, Australia (Chopra, 1943; Hattori, 1966; Onraedt, 1981; Udar & Awasthi, 1982b; Onraedt, 1985; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Singh, 1996; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & Nath, 2007; Singh & al., 2008a; Lai & al., 2008).

**Trocholejeunea infuscata** (Mitt.) Verd. in Ann. Bryol. Suppl. 4: 190. 1934; S.Hatt. in Hara, Flora of Eastern Himalaya 533. 1966. *Lejeunea infuscata* Mitt. in J. Proc. Linn. Soc. Bot. 5: 111. 1861.

*Specimen examined:* Terricolous and Corticolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1452); West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1453).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh)], Sri Lanka, Nepal, Bhutan, China, Myanmar, Philippines, Thailand (Mitten, 1861; Hattori, 1966; Awasthi & Srivastava, 1988; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Singh & Singh, 2007b; Singh & al., 2008a; Lai & al., 2008).

**Trocholejeunea sandvicensis** (Gottsche) Mizut. in Misc. Bryol. Lichenol. 2: 169. 1962; U.S.Awasthi & S.C.Srivast. in Proc. Indian Acad. Sci. (Plant Sci.) 98: 7. 1988; Mizut. in J. Hattori Bot. Lab. 66: 275. 1989. *Phragmicoma sandvicensis* Gottsche in Ann. Sci. Nat., Bot., Ser. 4, 8: 344. 1857. *Brachiolejeunea sandvicensis* (Gottsche) A.Evans in Trans. Connecticut Acad. Arts 10: 419. 1900. *Lejeunea sandvicensis* (Gottsche) A.Evans in Trans. Connecticut Acad. Arts 8: 253. 1892. *Mastigolejeunea sandvicensis* (Gottsche) Steph. in Bull. Herb. Boissier 5: 842. 1897.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Tadubi forest, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1407B).

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim), Western Himalaya (Himachal Pradesh, Uttarakhand), Western Ghats (Tamil Nadu)], Bhutan, Nepal, Sri Lanka, Pakistan, China, Hawaii, Thailand, Vietnam, Korea, Japan, Malaysia (Onraedt, 1981; Awasthi & Srivastava, 1988; Mizutani, 1989; Piippo, 1990; Long & Grolle, 1990; Zhu & So, 2001; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & al., 2008a; Lai & al., 2008; Singh & Singh, 2009; Dey & al., 2009).

**Tuzibeanthus chinensis** (Steph.) Mizut. in J. Hattori Bot. Lab. 24: 151. 1961; U.S.Awasthi & S.C.Srivast. in Geophytology 17: 17. 1987. *Ptychanthus chinensis* Steph., Sp. hepat. 4: 744. 1912.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Churachandpur district, Churachandpur, c.831 m, 01.03.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1454).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Manipur – present study), Bhutan, China, Myanmar, Thailand, Japan (Awasthi & Srivastava, 1987; Piippo, 1990; Long & Grolle, 1990; Yamada & Iwatsuki, 2006; Lai & al., 2008; Singh & Singh, 2009).

#### PELLIACEAE

**Pellia epiphylla** (L.) Corda in Opiz (ed.), Beitr. Zur Naturg. 12. 654. 1829; R.S.Chopra in J. Indian Bot. Soc. 22: 241. 1943. *Jungermannia epiphylla* L., Sp. pl. 2: 1135. 1753.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, c.1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1455).

*Distribution:* India [Western Himalaya (Himachal Pradesh), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)], Bhutan, China, Japan, North America, Macronesia, U.S.S.R., Europe (Kashyap, 1932; Chopra, 1943; Long & Grolle, 1990; Piippo, 1990; Schuster, 1992; Singh, 1996; Yamada & Iwatsuki, 2006; Singh & Nath, 2007; Singh & al., 2008a).

#### ANEURACEAE

**Aneura maxima** (Schiffn.) Steph., Spec. hepat. 1: 270. 1899. *Riccardia maxima* Schiffn. in Kaiserl. Akad. Wiss-Wien. Math.-Naturwiss Kl. Denkschr. 67: 178. 1898. *Aneura pellioides* (Horik.) Inoue in J.



Hattori Bot Lab. 25: 209. 1962. *Riccardia pellioides* Horik. in Bot. Mag., Tokyo 51: 429. 1937.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no 1455, 1456).

*Distribution:* India [Eastern Himalaya (Manipur – present study, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], China, Japan, Australia (Srivastava & Udar, 1976; Piippo, 1990; McCarthy, 2006; Yamada & Iwatsuki, 2006).

***Riccardia levieri*** Schiffn. in Oesterr. Bot. Z. 49: 130. 1899; S.C.Srivast. & Udar in Biol. Mem. 1: 132. 1976.

*Specimen examined:* Terricolous, and corticolous. India: Eastern Himalaya, Manipur, 1881 – 1882, G. Watt 7112; Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1458).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Manipur – present study, West Bengal), Western Ghats (Karnataka, Tamil Nadu), Central India (Madhya Pradesh)], Bhutan (Srivastava & Udar, 1976; Singh & Singh, 2009).

***Riccardia sikkimensis*** (Steph.) Pandé & K.P.Srivast. in J. Indian Bot. Soc. 37: 417. 1958; S.C.Srivast. & Udar in Biol. Mem. 1: 135. 1976. *Aneura sikkimensis* Steph., Sp. hepat. 6: 42. 1917.

*Specimen examined:* Terricolous, and corticolous. India: Eastern Himalaya, Manipur, Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1459).

*Distribution:* India [Western Himalaya, Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal)] (Srivastava & Udar, 1976; Singh, 1996; Singh & Nath, 2007; Singh & al., 2008a).

***Riccardia tenuicostata*** Schiffn. in Kaiserl. Akad. Wiss. Wien, Math.- Naturwiss Kl., Denkschr. 67: 166. 1898; S.C.Srivast. & Udar in Biol. Mem. 1: 128. 1976.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1460); Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1269B).

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Western Ghats (Tamil Nadu)], Indonesia, Malaysia (Srivastava & Udar, 1976; Srivastava, 1978; Singh, 1996; Singh & Nath, 2007; Singh & al., 2008a).

#### METZGERIACEAE

***Apometzgeria pubescens*** (Schrack) Kuwah. in Rev. Bryol. Lichenol. 34: 212. 1966; S.C.Srivast. & Udar in New Botanist, Int. Quart. J. Pl. Sci. Res. 2: 5. 1975. *Jungermannia pubescens* Schrank, Prim. Fl. Schles 231. 1792. var. ***pubescens***.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1461A, 1523A); Hongava Hill, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1462).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand) Eastern Himalaya (Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, China, Thailand, Japan, Korea, Europe, North and South America (Kashyap, 1929, 1932; Kuwahara, 1966; Srivastava & Udar, 1975; Long, 1979; Long & Grolle, 1990; Piippo, 1990; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & al., 2008a; Lai & al., 2008).

***Metzgeria conjugata*** Lindb. in Acta Soc. Sci. Fenn. 10: 495. 1875; D.Singh & D.K.Singh in Geophytology 37: 47. 2008.

*Specimen examined:* Corticolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1463); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1432A, 1440A); Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1526A).

*Distribution:* India [Western Himalaya (Jammu & Kashmir), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim)], China, Europe, Australia, Africa, North and South America (Piippo, 1990;

Schuster, 1992; Grolle, 1995; Paton, 1999; McCarthy, 2006; Singh & al., 2007; Singh & Singh, 2008; Dey & al., 2009).

**Metzgeria furcata** (L.) Dumort., Recueil observ. Jungerm.: 26. 1835. *Jungermannia furcata* L., Sp. pl. 1136. 1753. *Metzgeria crispula* Herzog in Ann. Bryol. 12: 72. 1939. *Metzgeria decipiens* (C.Massal.) Schiffn. in Engler, Forschung. Gazelle 4 (4), Bot. 43. '1889' 1890. *M. furcata* var. *decipiens* C.Massal. in Nuovo Giorn. Bot. Ital. 17: 256. 1885. var. **furcata**.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Hongva forest, 27.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1522).

*Distribution*: India [Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Assam, Sikkim, West Bengal), Western Himalaya (Uttarakhand), Western Ghats (Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Japan, Korea, Philippines, Thailand, Indonesia, Hawaii, New Guinea, New Caledonia, Europe, Africa, North and South America, Australia, New Zealand (Kuwahara, 1966, 1978, 1986; Srivastava & Udar, 1975; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Schuster, 1992; Grolle, 1995; So, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & al., 2007; Verma & Srivastava, 2008; Lai & al., 2008; Dey & al., 2009).

*Note*: Lal (1979b, 2003) reported *Metzgeria nilgiriensis* Udar & S.C.Srivast. from Manipur. However, examination of the specimens deposited in CAL revealed them to belong to *Metzgeria furcata*.

**Metzgeria leptoneura** Spruce in Trans. & Proc. Bot. Soc. Edinburgh. 15: 555. 1885; M.L.So in J. Hattori Bot. Lab. 94: 176. 2003. *Metzgeria hamata* Lindb. in Acta Soc. Founa Fl. Fenn. 1: 25. 1877; S.C.Srivast. & Udar in New Botanist, Int. Quart. J. Pl. Sci. Res. 2: 38. 1975.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1464); Ukhrul district, Sirohi Hill, c.1900 m, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1521A).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Manipur – present study, Meghalaya, Sikkim, West Bengal)], Nepal, Bhutan, Sri Lanka, China, Indonesia, Korea, Japan, Malaysia, Philippines, Thailand, Australia, Africa (Chopra, 1943; Hattori, 1966; Srivastava & Udar, 1975; Long, 1979; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Grolle, 1995; Wigginton & Grolle, 1996; So, 2003; McCarthy, 2006; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & al., 2008a; Lai & al., 2008).

**Metzgeria lindbergii** Schiffn. in Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 67: 182. 1898; M.L.So in J. Hattori Bot. Lab. 94: 176. 2003. *Metzgeria conjugata* Lindb. var. *japonica* S.Hatt in J. Hattori Bot. Lab. 15: 80. 1955. *Metzgeria conjugata* Lindb. subsp. *japonica* (S.Hatt.) Kuwah. in J. Hattori Bot. Lab. 20: 135. 1958.

*Specimen examined*: Corticolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1465).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur–present study, Sikkim, West Bengal)], Nepal, Bhutan, Sri Lanka, China, Japan, Korea, Indonesia, Malaysia, Thailand, Philippines, Australia (Srivastava & Udar, 1975; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; So, 2003; McCarthy, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & al., 2007; Singh & al., 2008a; Lai & al., 2008).

#### TARGIONIACEAE

**Targionia hypophylla** L., Sp. pl. 2: 1136. 1753; Udar & A.Gupta in Geophytology 11: 83. 1981.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1466).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Punjab & West Rajasthan (Rajasthan)], Nepal, Bhutan, China, Japan, Thailand, Australia, North & South America

(Kashyap, 1929; Chopra, 1943; Hattori, 1966; Long & Grolle, 1990; Piippo, 1990; Schuster, 1992; Singh, 1996; Mcarthy, 2006; Yamada & Iwatsuki, 2006; Asthana & Nath, 2007; Singh & al., 2008a; Lai & al., 2008).

#### CONOCEPHALACEAE

**Conocephalum conicum** (L.) Dumort., Comment. bot. 115. 1822; Sushil K.Singh & D.K.Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 313. 2009. *Marchantia conica* L., Sp. pl. 2: 1138. 1753.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, on way to Kangpoki, 15.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1467, 1468, 1469, 1470); Ukhrul district, Sirohi Hill, 25.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1471, 1472, 1473).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur – present study, Sikkim, West Bengal)], Nepal, Bhutan, China, Korea, Japan, CIS, Europe, North Africa, Macronesia, North America (Kashyap, 1929; Chopra, 1943; Hattori, 1971; Long & Grolle, 1990; Piippo, 1990; Singh, 1996; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Singh & al., 2008a; Singh & Singh, 2009).

#### AYTONIACEAE

**Asterella blumeana** (Nees) Kachroo in J. Univ. Gauhati 3: 130. 1952; D.G.Long in Bryophyt. Biblioth. 63: 183. 2006. *Fimbriaria blumeana* Nees in Gottsche, Lindenb. & Ness, Syn. hepat. 564. 1846.

Imphal, D.B. Deb, s.n. (fide Kachroo & Deb, 1954).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya)], Indonesia (Kachroo & Deb, 1954; Long, 2006; Singh & Nath, 2007).

**Asterella khasyana** (Griff.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954; D.G.Long in Bryophyt. Biblioth. 63: 169. 2006. *Octoskepos khasyanum* Griff., Not. pl. asiat 2: 343. 1849. *Asterella butleri* (Steph.) Kachroo in J. Indian Bot. Soc. 56: 74. 1977. *Asterella papulosa* (Steph.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954. *Asterella blumeana* auct. plur. non (Nees) Kachroo in J. Hattori Bot. Lab. 12: 36. 1954.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1474).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal), Punjab & West Rajasthan (Rajasthan), Central India (Madhya Pradesh), Western Ghats (Maharashtra, Karnataka, Tamil Nadu)], Pakistan, Nepal, Bhutan, China, Thailand, Indonesia, Philippines (Long & Grolle, 1990; Piippo, 1990; Nair & al., 2005; Long, 2006; Singh & al., 2008a; Lai & al., 2008; Singh & Singh, 2009).

**Asterella wallichiana** (Lehm. & Lindenb.) Pandé & al. ex Grolle, Ergebnisse der Forschungs-Unternehmens Nepal Himalaya 1: 262. 1966; D.G.Long in Bryophyt. Biblioth. 63: 144. 2006. *Fimbriaria wallichiana* Lehm. & Lindenb., Nov. Stirp. pug. 4: 4. 1832. *Asterella angusta* (Steph.) Mahab. & Bhate in J. Univ. Bombay 13: 5. 1945. *Asterella maculata* (Steph.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954. *Asterella golanii* (Steph.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954. *Asterella indica* (Steph.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954. *Asterella mescarana* (Steph.) Pandé & al. in J. Hattori Bot. Lab. 11: 8. 1954. *Asterella mysorensis* (R.S.Chopra) Pandé & al. in J. Hattori Bot. Lab. 11: 9. 1954; *Astrella sanguinea* (Lehm. & Lindenb.) Kachroo in J. Hattori. Bot. Lab. 19: 4. 1958; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954.

*Specimen examined*: Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1475).

*Distribution*: India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Sikkim, West Bengal), Central India (Madhya Pradesh), Gangetic Plains (Uttar Pradesh), Western Ghats (Maharashtra, Karnataka, Kerala, Tamil Nadu)], Pakistan, Nepal, Bhutan, Bangladesh, China, Myanmar, Thailand, Philippines, Indonesia, Japan, Papua New Guinea (Chopra, 1943; Kachroo & Deb, 1954; Long, 2006; Asthana & Nath, 2007; Singh & Singh, 2007c; Singh & al., 2008a; Lai & al., 2008).

**Plagiochasma appendiculatum** Lehm. & Lindenb., Nov. stirp. pug. 4: 14. 1832; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954; Sushil K.Singh & D.K.Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 342. 2009.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1476).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, West Bengal), Punjab & West Rajasthan (Punjab, Rajasthan), Gangetic Plains (Uttar Pradesh), Central India (Madhya Pradesh), Western Ghats (Maharashtra, Tamil Nadu)], Afghanistan, Pakistan, Nepal, Bhutan, Bangladesh, China, Myanmar, Indonesia, Philippines, Vietnam, Europe, Africa (Chopra, 1943; Kashyap, 1929; Kachroo & Deb, 1954; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Singh, 1996; Wigginton & Grolle, 1996; Singh & al., 2008a; Singh & Singh, 2009).

**Reboulia hemisphaerica** (L.) Raddi, Opusc. Sci. 2: 357. 1818; Sushil K.Singh & D.K.Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 355. 2009. *Marchantia hemisphaerica* L., Sp. pl. 2: 1138. 1753; *Reboulia hemisphaerica* (L.) Raddi var. *pangiensis* Kashyap, Liverw. W. Himal 1: 74. 1929. Kachroo & D.B.Deb in J. Univ. Gauhati 5: 120. 1954.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c.1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1477, 1478, 1479, 1480, 1481); On way to Kangpoki, 15.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1482).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Jammu & Kashmir, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur, Meghalaya, Sikkim, West Bengal), Punjab & West Rajasthan (, Rajasthan), Gangetic Plains (Uttar Pradesh), Central India (Madhya Pradesh), Western Ghats (Karnataka, Tamil Nadu)], Afghanistan, Pakistan, Nepal, Bhutan, Sri Lanka, China, Indonesia, Japan, Turkey, Syria, Iran, C.I.S., New Guinea, Macronesia, Europe, Australia, New Zealand, Africa, North & South America (Kachroo & Deb, 1954; Hattori, 1966; Onraedt, 1981; Long & Grolle, 1990; Piippo, 1990; Schuster, 1992; Singh, 1996; Paton, 1999; Yamada & Iwatsuki, 2006; McCarthy, 2006; Singh & al., 2008a; Singh & Singh, 2009).

#### MARCHANTIACEAE

**Dumortiera hirsuta** (Sw.) Nees in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 410. 1824; Sushil K.Singh & D.K.Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 377. 2009. *Marchantia hirsuta* Sw., Prodr. 145. 1788.

*Specimen examined:* Terricolous, and corticolous. India: Eastern Himalaya, Manipur, Senapati district, near Mao, c.1757 m, 13.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1483); Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1484, 1485, 1486); Liton, 19.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1487, 1488A); Ukhrul district, Sirohi Hill, c.1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1489, 1490); Ukhrul district, Tushen, 21.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1489, 1490, 1491, 1492, 1493, 1494, 1527); West Imphal district, Jiribam, 05.03.1984, J. P. Ghosh 58018; Tamenglong district, 10.03.1984, J. P. Ghosh 58039.

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Assam, Manipur – present study, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Western Ghats (Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Korea, Japan, Indonesia, Thailand, Polynesia, Philippines, Samoa, Australia, Africa, Europe, North & South America (Kashyap, 1929; Hattori, 1966, 1975; Grolle & Schultze-Motel, 1972; Onraedt, 1981; Tan & Engel, 1986; Srivastava & Sharma, 1987; Long & Grolle, 1990; Piippo, 1990; Singh, 1996; Paton, 1999; Schuster, 1992; Singh, 1996; Wigginton & Grolle, 1996; McCarthy, 2006; Song & Yamada, 2006; Yamada & Iwatsuki, 2006; Asthana & Nath, 2007; Singh & al., 2008a; Lai & al., 2008; Singh & Singh, 2009).

**Marchantia linearis** Lehm. & Lindenb. in Lehmann, Nov. stirp. pug. 4: 8. 1832; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 119. 1954; V.B.Singh in Bull. Lucknow Natl. Bot. Gard. 125: 13. 1966.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1497); Bhutang khola, 06.03.1984, J. P. Ghosh 58027, 58028, 58032; Tamenglong district, on way to Dhillong, 13.03.1984, J. P. Ghosh, 58071, 58073.

*Distribution:* India [Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Punjab & West Rajasthan (Punjab), Western Ghats (Kerala)], Pakistan, Nepal, Indonesia (Mitten, 1861; Chopra, 1943; Kachroo & Deb, 1954; Singh, 1966; Nair & al., 2005; Asthana & Nath, 2007; Singh & al., 2008a).

**Marchantia paleacea** Bertol. in Opusc. Sci. 1: 242. 1817; Sushil K. Singh & D.K. Singh, Hepaticae and Anthocerotae of Great Himalayan National Park and its environs (HP), India 381. 2009. *Marchantia nepalensis* Lehm. & Lindenb. in Lehmann, Nov. stirp. pug. 4: 10. 1832; Kachroo & D.B. Deb in J. Univ. Gauhati 5: 119. 1954. *Marchantia nitida* Lehm. & Lindenb. in Lehmann, Nov. stirp. pug. 4: 11. 1832. subsp. **paleacea**.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Kankui forest, 18.03.1984, J. P. Ghosh 58044.

*Distribution:* India [Western Himalaya (Jammu & Kashmir, Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur, Meghalaya, Sikkim, West Bengal), Gangetic Plain (West Bengal), Central India (Madhya Pradesh), Western Ghats (Tamil Nadu)], Pakistan, Nepal, Bhutan, China, Japan, Philippines, Indonesia, Korea, Polynesia, Melanesia, Macronesia, Africa, Europe, North & South America (Mitten, 1861; Kashyap, 1929; Chopra, 1943; Kachroo & Deb, 1954; Hattori, 1966; Singh, 1966; Tan & Engel, 1986; Bischler, 1989; Long & Grolle, 1990; Piippo, 1990; Paton, 1999; Schuster, 1992; Wigginton & Grolle, 1996; Yamada & Iwatsuki, 2006; Singh & al., 2008a; Singh & Singh, 2009).

**Marchantia subintegra** Mitt. in J. Proc. Linn. Soc., Bot. 5: 125. 1861; V.B. Singh in Natl. Bot. Gard. Bull. 125: 23. 1966. *Marchantia papulosa* Amakawa in Hara, Flora of Eastern Himalaya 535. 1966.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Tamenglong district, on way to Dhillong, 13.03.1984, J. P. Ghosh 58076.

*Distribution:* India [Eastern Himalaya (Arunchal Pradesh, Assam, Manipur – present study, Sikkim, West Bengal), Nepal, Bhutan (Mitten, 1861; Chopra, 1943; Singh, 1966; Hattori, 1966, 1975; Bischler, 1989; Long & Grolle, 1990; Singh & al., 2008a).

#### MONOSOLENIACEAE

**Monosolenium tenerum** Griff., Ic. Pl. Asiat. 2, Pl. 75. B. f. 1; Not. Pl. Asiat. 2: 341. 1849; Sushil K. Singh & D.K. Singh in Curr. Sci. 92: 1483. 2007.

Imphal, S.L. Hora, s.n. (fide Kashyap, 1923).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Assam, Manipur)], China, Thailand, Japan, Hawaii (Kashyap, 1923; Piippo, 1990; Yamada & Iwatsuki, 2006; Singh & Singh, 2007; Singh & Singh, 2007c; Lai & al., 2008).

#### RICCIACEAE

**Riccia billardieri** Mont. & Nees, Syn. hepat. 602. 1846; Udar in Curr. Sci 26: 20. 1955; Pandé & Udar in J. Indian Bot. Soc. 36: 570. 1957; K.P. Srivast. in Bull. Lucknow Natl. Bot. Gard. 104: 27. 1964.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Bhutang khola, 06.03.1984, J. P. Ghosh 58024.

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Assam, Manipur – present study, Sikkim, West Bengal), Central India (Madhya Pradesh), Gangetic plains (Uttar Pradesh), Punjab & West Rajasthan (Rajasthan), Western Ghats (Karnataka)], Indonesia, Thailand, Vietnam, Australia (Meijer, 1958; Srivastava, 1964; Tan & Engel, 1986; McCarthy, 2006; Lai & al., 2008; Dey & al., 2009).

**Riccia frostii** Austin in Bull. Torrey Bot. Club. 6: 17. 1875; K.P. Srivast. in Bull. Lucknow Natl. Bot. Gard. 104: 51. 1964. *Riccia sanguinea* Kashyap in J. Bombay Nat. Hist. Soc. 24: 349. 1916.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1506).

*Distribution:* India [Western Himalaya, Eastern Himalaya (Assam, Manipur, Sikkim), Gangetic plains (West Bengal, Uttar Pradesh), Punjab & West Rajasthan (Rajasthan), Western Ghats (Tamil Nadu)], China, Vietnam (Srivastava, 1964; Piippo, 1990; Singh & al., 2008a).

**Ricciocarpos natans** (L.) Corda in Opiz (ed.), Beitr. Zur Naturg. 12: 651. 1829; D.B. Deb in Sci. & Cult. 19: 353. 1954; K.P. Srivast. in Natl. Bot. Gard. Bull. 104: 57. 1964. *Riccia natans* L. Syst. nat. ed. 10: 1339. 1759.

Loktak lake, D.B. Deb, s.n. (fide Deb, loc.cit.).

*Distribution:* India [Western Himalaya, Western Himalaya (Jammu & Kashmir, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Assam, Manipur, Meghalaya), Gangetic plains (West Bengal), Punjab & West Rajasthan (Punjab)], Pakistan, China, Japan, Philippines, Thailand, Europe, Africa, Australia, North and South America (Biswas & Calder, 1936; Deb, 1954; Tan & Engel, 1986; Piippo, 1990; Singh, 1996; Kumar & al., 2005; McCarthy, 2006; Yamada & Iwatsuki, 2006; Lai & al., 2008).

#### ANTHOCEROTACEAE

**Anthoceros bharadwajii** Udar & A.K. Asthana in Proc. Indian Natl. Sci Acad., B 51: 484. 1985; A.K. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 42: 41. 1991.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1269A); Savatvakhong, 22.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1507); Bhutang khola, 06.03.1984, J. P. Ghosh 58021, 58025, 58026.

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur, Meghalaya, West Bengal), Western Ghats (Karnataka, Kerala, Maharashtra)] (Asthana & Srivastava, 1991; Singh & Singh, 2009).

**Anthoceros erectus** Kashyap in New Phytol. 14: 9. 1915; A.K. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 42: 37. 1991. *Anthoceros stephanii* (Steph.) L.P. Khanna in J. Indian Bot. Soc. 15: 235. 1936.

Ukhrul, A. Kumar and U.S. Awasthi 3675/79, 3681/79 (LWU) (fide Asthana & Srivastava, loc.cit.).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Manipur), Western Ghats (Kerala, Tamil Nadu)] (Asthana & Srivastava, 1991).

**Anthoceros punctatus** L., Sp. hepat. 2: 1139. 1753; Kachroo in Sci. & Cult. 18: 284. 1952; A.K. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 42: 46. 1991.

Manipur, (fide Chopra, 1943; Kachroo, 1952).

*Distribution:* India [Western Himalaya (Khadamba), Eastern Himalaya (Manipur)], China, Japan, Europe, Africa, New Caledonia North & South America (Kachroo, 1952; Piippo, 1990; Asthana & Srivastava, 1991; Yamada & Iwatsuki, 2006).

**Folioceros assamicus** D.C. Bhardwaj in Geophytology 1: 10. 1971; A.K. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 42: 67. 1991.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Senapati district, Mao, c. 1757 m, 14.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1511).

*Distribution:* India [Eastern Himalaya (Assam, Manipur – present study, Meghalaya)], Thailand (Asthana & Srivastava, 1991; Asthana & Nath, 2002; Lai & al., 2008).

**Phaeoceros carolinianus** (Michx.) Prosk. in Bull. Torrey Bot. Club. 78: 347. 1951. *Anthoceros carolinianus* Michx., Flora bor.-americ. 2: 280. 1803. *Anthoceros jackii* Steph., Sp. hepat. 6: 427. 1923. *Phaeoceros laevis* (L.) Prosk subsp. *carolinianus* (Michx.) Prosk. in Rapp. & Comm. VIII Congr. Int. Bot. Paris 14-16: 69. 1954; A.K. Asthana & S.C. Srivast. in Bryophyt. Biblioth. 42: 125. 1991. *Anthoceros gollani* Steph., Sp. hepat. 5: 987. 1916. *Phaeoceros tenax* (Steph.) Udar & D.K. Singh in Geophytology 11: 257. *Phaeoceros cataractarum* (Steph.) Udar & D.K. Singh in Geophytology 11: 257. 1981. *Phaeoceros lamellisporous* (Steph.) Udar & D.K. Singh in Geophytology 11: 257. 1981.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, West Mountain, 24.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1512); Churachandpur district, Churachandpur, c.831 m, 01.03.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1513).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur, Meghalaya, Sikkim, West Bengal), Punjab & West Rajasthan (Rajasthan), Central India (Madhya Pradesh), Western Ghats (Tamil Nadu)], Nepal, Bhutan, Sri Lanka, China, Myanmar, Philippines, Thailand, Japan, Korea, Melanesia, Macronesia, Polynesia, Australia, Europe, Africa, North & South America (Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Asthana & Srivastava, 1991; Schuster, 1992; Singh, 1996; Paton, 1999; Yamada & Iwatsuki, 2006; McCarthy, 2006; Song & Yamada, 2006; Singh & al., 2008a; Lai & al., 2008; Singh & Singh, 2009).

**Phaeoceros kashyapii** A.K.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 42: 129. 1991.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1514).

*Distribution:* India [Western Himalaya (Uttarakhand), Eastern Himalaya (Manipur – present study)] (Asthana & Srivastava, 1991).

**Phaeoceros laevis** (L.) Prosk. in Bull. Torrey Bot. Club 78: 347. 1951. *Anthoceros laevis* L., Sp. pl. 2: 1139. 1753; Kachroo & D.B.Deb in J. Univ. Gauhati 5: 119. 1954. *Anthoceros indicus* Steph. Spec. hepat. 5: 1002. 1916. *Anthoceros longii* Steph. Spec. hepat. 5: 1003. 1916. *Phaeoceros butleri* (Steph.) Udar & D.K.Singh in Geophytology 11: 257. 1981. *Phaeoceros laevis* (L.) Prosk subsp. *laevis* Prosk. in Rap. & Comm. VIII Congr. Int. Bot. Paris 14-16: 69. 1954; A.K.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 42: 122. 1991.

*Specimen examined:* Terricolous. India: Eastern Himalaya, Manipur, on way to Kangpoki, 15.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1516); Waka forest, 17.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1517, 1518); Ukhrul district, Sirohi Hill, c.1900 m, 20.02.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1519); Churachandpur district, Churachandpur, c.831 m, 01.03.1978, J. Lal & B. D. Kar, s.n. (acc. no. 1520).

*Distribution:* India [Western Himalaya (Himachal Pradesh, Uttarakhand), Eastern Himalaya (Arunachal Pradesh, Manipur, Meghalaya, Sikkim, West Bengal), Punjab & West Rajasthan (Rajasthan), Western Ghats (Karnataka, Kerala, Maharashtra, Tamil Nadu), Central India (Madhya Pradesh)], Nepal, Pakistan, China, Japan, Philippines, Turkey, C.I.S., Australia, Europe, North America (Kachroo & Deb, 1954; Piippo, 1990; Asthana & Srivastava, 1991; Schuster, 1992; Singh, 1996; Yamada & Iwatsuki, 2006; McCarthy, 2006; Asthana & Nath, 2007; Singh & al., 2008a; Singh & Singh, 2009).

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## मणिपुर के लिवरवर्ट्स एवं हार्नवर्ट्स का संक्षिप्त वनस्पतिजातीय वर्णन

देवेन्द्र सिंह, मोनालिसा दे एवं डी.के. सिंह

### सार संक्षेप

प्रस्तुत वनस्पतिजात में मणिपुर से लिवरवर्ट्स के 46 वंश एवं 20 कुलों की 111 जातियाँ एवं एक प्रभेद तथा हार्नवर्ट्स कुल में 3 वंशों की सात जातियाँ सम्मिलित हैं। इनमें से 92 वर्गकों (91 जाति एवं एक प्रभेद) का मणिपुर राज्य से पहली बार अभिलेख किया गया है। *बजानिया ओरिएंटलिस* (स्टिफानी) परिहार हिमालय क्षेत्र के लिए नया रिकॉर्ड है जबकि पूर्वी हिमालय हरितोदिभदीय-भौगोलिक (ब्रायोज्योग्राफिकल) क्षेत्र के लिए *पोरेला मैडागास्करिएंसिस* (वीस एवं माँटेन) ट्रेविसान एवं *फियोसिरॉस कश्यपाई* ए.के. अस्थना एवं एस.सी. श्रीवास्तव नये हैं।

## ALGAL DIVERSITY ON AND AROUND *LODOICEA MALDIVICA* (J.E.GMEL.) PRES. (DOUBLE COCONUT) IN AJC BOSE INDIAN BOTANIC GARDEN, HOWRAH

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### ABSTRACT

38 algal taxa belonging to 6 Classes viz. Cyanophyceae (15), Xanthophyceae (2), Chrysophyceae (2), Bacillariophyceae (10), Euglenophyceae (2) and Chlorophyceae (7) were recorded between July - October, 2010 from *Lodoicea maldivica* (J. E. Gmel.) Pres. (Double Coconut) and its surrounding area in the Acharya Jagadish Chandra Bose Indian Botanic Garden (AJCBIBG), Howrah. This is the first report on algae on and around this interesting palm.

**Keywords :** Algae, Diversity, Double Coconut Palm.

### INTRODUCTION

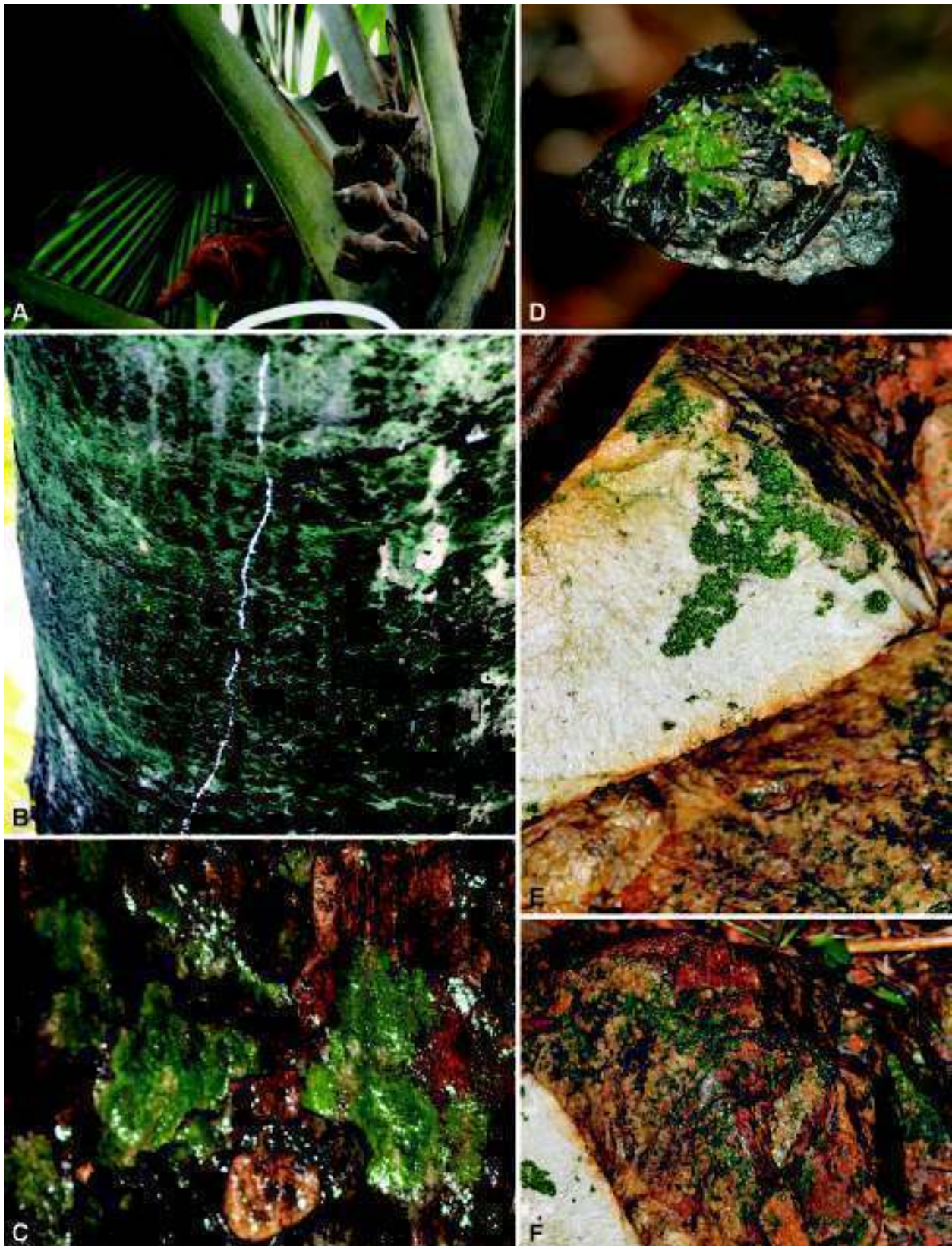
The term “algae” merely refers to aquatic organism capable of photosynthesis and so applies to several groups which photosynthesize and manufacture their own food except a few forms of Cyanobacteria which get sufficient supply of energy in the form of glucose. The first primitive form of life called as prokaryotes may have originated c. 3.5 billion years ago, whereas blue-green algae performing photosynthesis originated c. 3.0 billion years ago (Cassidy, 2009) and were predominant even during Precambrian era (Schopf, 1975, 1994, 1996). Later on, eukaryotic algal forms also evolved at different time period and in transition also recorded from semi-aquatic (swamp and marshy land) to terrestrial habitat and even on different objects and thus widely called as ubiquitous. Taxonomically, algae has been classified into 11 Class pertaining to Cyanophyceae, Xanthophyceae, Cryptophyceae, Chrysophyceae, Dinophyceae, Bacillariophyceae, Euglenophyceae, Chlorophyceae, Chloromonodineae, Phaeophyceae and Rhodophyceae (Fritsch, 1935, 1945).

*Lodoicea maldivica* (J.E.Gmel.) Pres. (Arecaceae), a very important and interesting rare giant palm listed in Red Data Book was planted during 1894 at the centre of an octagonal metallic enclosure in AJC Bose Indian Botanic Garden, Howrah. The microclimatic conditions provided not only helped this plant in its survival but they also helped other microscopic forms like algae to thrive on soil, pebbles, boulders and stones. The presence of diverse algal forms tempted the authors to study the same in detail as no one studied it earlier. However, few studies on other palm species like *Oreodoxa regia* have been carried out by Biswas (1932) and Kamat and Harankhedkar (1976), on *Cocos nucifera* by Brühl and Biswas (1923) and Kamat (1963a) whereas Rao (1937, 1938), Banerji (1938), Kamat (1963b, 1967, 1968, 1972, 1974), Kamat and Harankhedkar (1976) and Gupta (2008) recorded algal forms from different tree species belonging to Angiosperm and Gymnosperm. Besides, algal forms have also been recorded from acid bogs and alkaline soils by Prasad and Srivastava (1968), Prasad & al. (1978) and from fertile and desert soils by Holsinger (1935), Gonzalves and Gangla (1949), Pandey (1965), Prasad and Srivastava (1968), Bharati and Bongale (1975), Bongale and Bharati (1980, 1984), Goyal & al. (1984), Bongale (1986, 1987a, b, c), Angadi (1990), Shakuntala (1990), Suseela and Goyal (1994), Singh & al. (1995) and Singh and Srivastava (2002).

### MATERIAL AND METHODS

The Large Palm House- an octagonal metallic enclosure in the Acharya Jagadish Chandra Bose Indian Botanic Garden is selected as sampling site for collection of samples of algae growing on a rare palm tree, listed in Red Data Book i.e. *Lodoicea maldivica* (J.E.Gmel.) Pres. as well as on soil, pebbles, boulders and stones (**Fig. 1**) from July to October, 2010. Before a fortnight from date of collection of samples, the climatic





**Fig.1** Samples Collected from different parts of *Lodoicea maldivica* (J.E.Gmel.) Pres. **A.** From upper region and from flower; **B.** From middle region bluish-greenish algal patch on tree trunk; **C.** From lower region green algal patch on tree trunk; **D - F.** Algal patches on Pebble, Boulder and Stone respectively.

data like temperature, rainfall and relative humidity including sunrise, sunset were collected. Initially, before a fortnight from collection of samples, the climatic condition was found mostly cloudy and bright sunshine was limited for few days. The temperature ranged from 25.4°C to 30.4°C, rainfall nil to 74.0 mm and relative humidity from 59% to 98%. The procedure adopted for collection of samples from different parts of the tree and surrounding area is briefly described as follows :

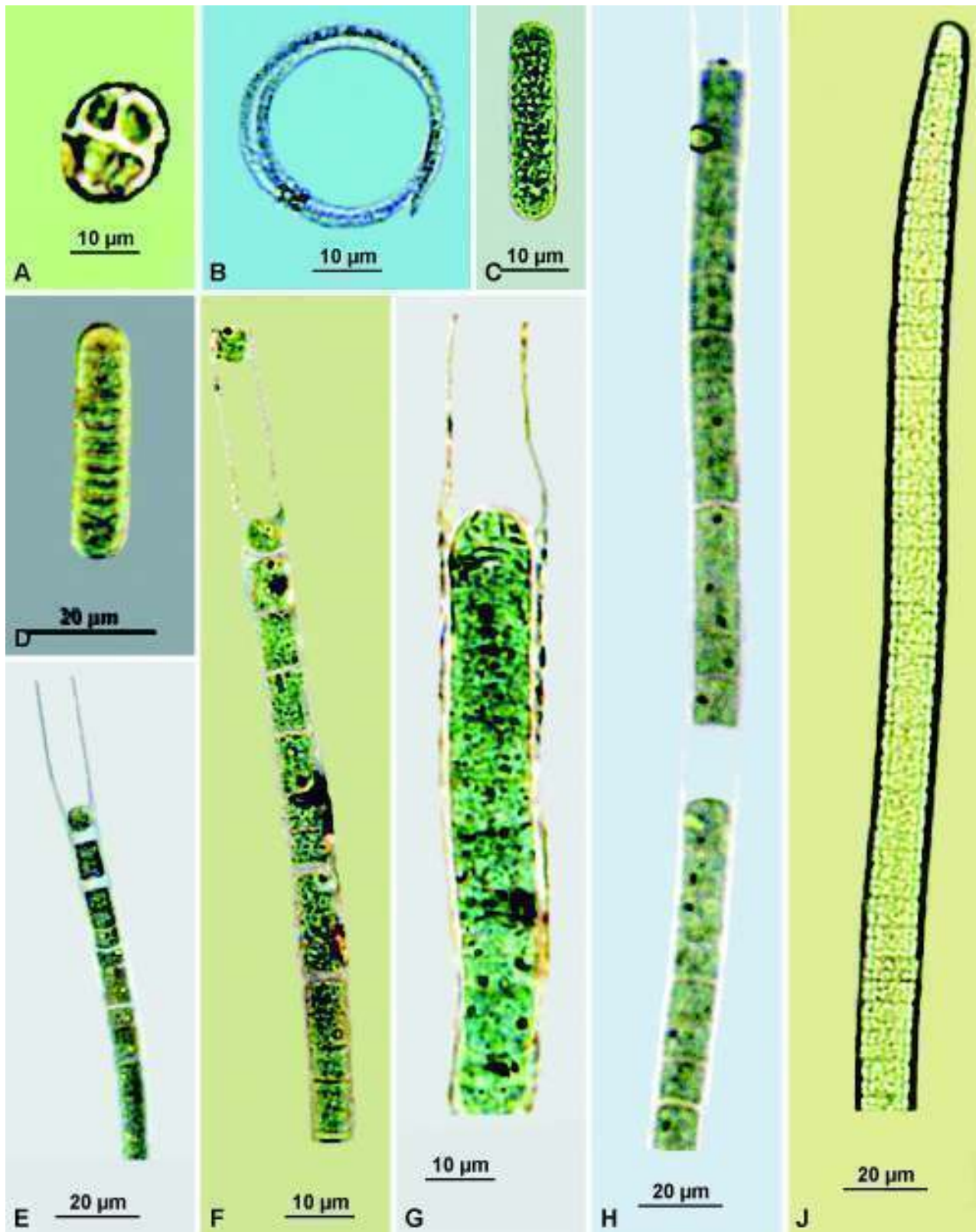
Samples from different level of tree trunk like upper, middle and lower portion including petiole and flower, soil and pebble / boulder / stone lying around the precious tree were collected by gently scraping green and bluish-green algal patches by sterilized scalpel and forceps and collected in 15 ml screw cap glass Borosil specimen vial and brought to the laboratory. Further added double distilled water to make the volume 10 ml in each vial and preserved the specimens by adding 2 to 4 drops of 4% Formalin. All specimens were observed under Leica DM 2500 Microscope using Leica QWin V 3.2 Image Processing and Analysis Software. The photomicrographs were taken by using Leica DFC 500 digital camera attached with the microscope. The specimens were identified consulting standard monographs, books and proceedings of Geitler (1932), Tiffany and Britton (1952), Desikachary (1959), Prescott (1982), Starmach (1985), Kant and Gupta (1998), Komárek and Anagnostidis (1998, 2005), Bertalot and Genkal (1999), Kristiansen and Preisig (2007) and Karmmer and Bertalot (2008a, b). The above studied specimens are maintained in the Ecology Section, Central National Herbarium, Botanical Survey of India (CAL).

## RESULT AND DISCUSSION

During study, altogether 38 algal species were recorded from *Lodoicea maldivica* (J.E.Gmel.) Pres. as well as from soil and pebbles / boulders / stones existing around. The recorded 38 algal forms belong to the Class Cyanophyceae (15), Bacillariophyceae (10), Chlorophyceae (7) and 2 each to the Class Xanthophyceae, Euglenophyceae and Chrysophyceae (Table 1 & 2, Fig. 5). The recorded number of algal species is 4 and 9 times more than earlier reports from other plant species by Kamat and Harankhedkar (1976) and Gupta (2008) respectively.

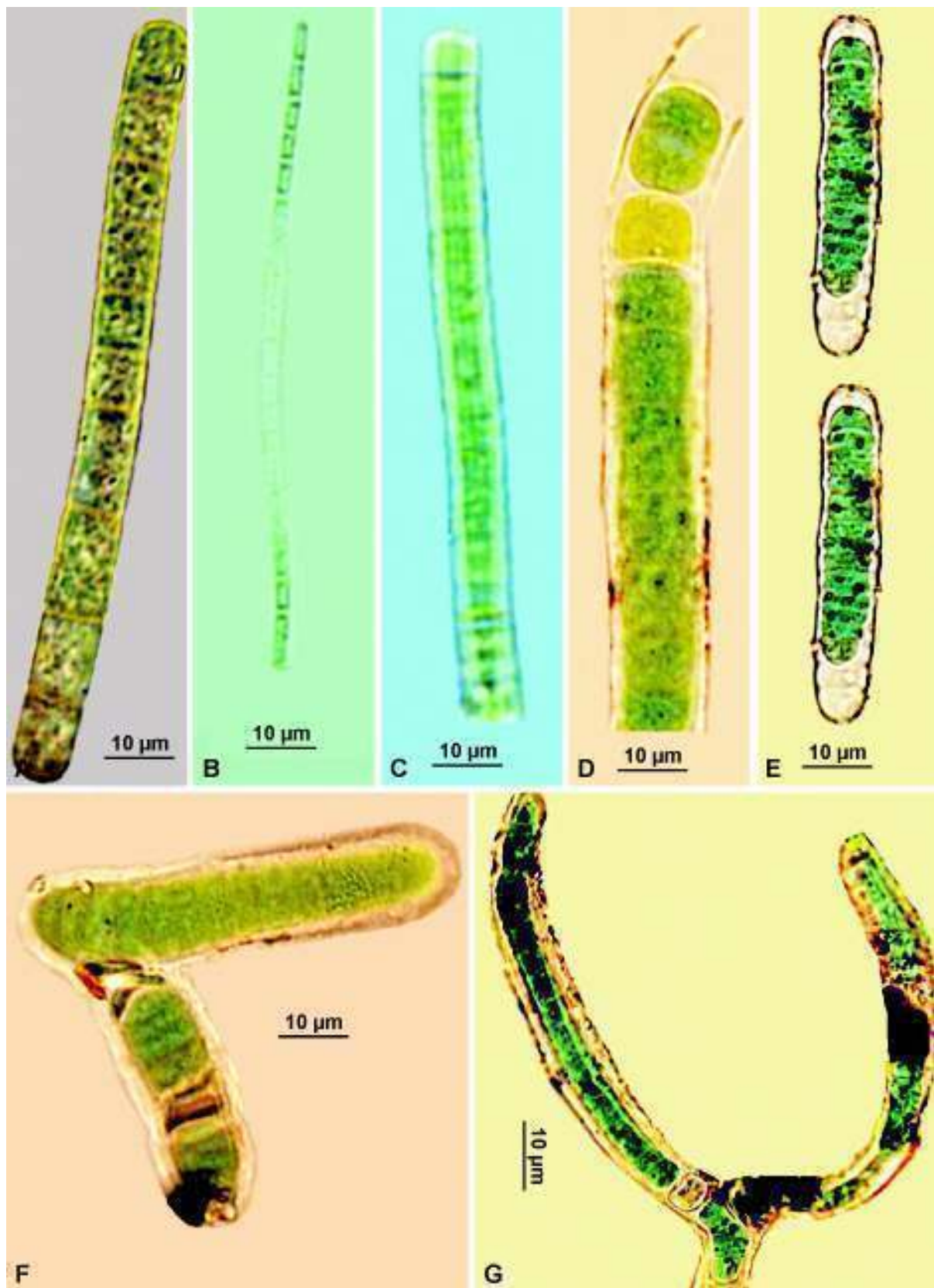
However, out of 38 species reported from *Lodoicea maldivica* (J.E.Gmel.) Pres., only 6 species namely *Chroococcus minutus* (Kütz.) Nägeli, *Oscillatoria tenuis* C. Agardh ex Gomont, *Scytonema ocellatum* Lyngb. ex Bornet & Flahault, *Chlorococcum humicola* (Nägeli) Rabenh., *Chlorella vulgaris* Beij. and *Protococcus viridis* C. Agardh have also been reported earlier by the Brühl and Biswas (1923), Biswas (1932), Kamat (1972) and Gupta (2008) from tree trunk (bark) of other plant species. The quantitative occurrence of such a high number of algal species on *Lodoicea maldivica* (J. E. Gmel.) Pres. and surrounding area is amazing which may be due to moist and suitable environmental conditions facilitated for most part of the year within the enclosure as a result of two different climbers i.e. *Antigonon leptopus* Hook. & Arn. and *Porana paniculata* Roxb. While studying vertical profile of algae (Class-wise) on tree trunk at upper, middle and lower portion, maximum 7 Cyanophycean forms were recorded at middle zone (Table 1) possibly due to compactness of leaf scar which may have facilitated to lodge maximum soil and mineral contents generated due to dead cells of earlier grown algal forms which may helped in holding sufficient moisture / water content for longer time period followed by 5 and 3 species at lower and upper part respectively. Maximum 5 Bacillariophycean forms were recorded at lower zone possibly due to existence of maximum patches of other algal forms. Maximum 3 Chlorophycean forms were recorded from the upper portion possibly due to maximum exposure of sunlight and relative humidity followed by lower zone. Besides, 2 species each were recorded from petiole and flower, 3 species from soil and 6 species from pebbles / boulders / stones belonging to different Classes. During the study some of the species recorded are common on more than one substratum like- *Lyngbya contorta* Lemmerm. from middle part of the tree trunk and stone around the tree, *Fragilaria construens* (Ehrenb.) Grunow from upper part of the tree trunk as well as soil around the tree, *Chlorococcum humicola* (Nägeli) Rabenh. from stone around the tree and lower part of the tree trunk. Besides this, *Chlorella vulgaris* Beij. is reported from almost all part of the Palm viz. lower part of the tree trunk, stone around the tree, leaf scarp, flower, bryophyte near tree. In addition to that, some of species confined in particular area





**Fig. 2** Cyanophyceae from *Lodoicea maldivica* (J.E.Gmel.) Pres. and its surrounding area: **A.** *Chroococcus minutus* (Kütz.) Nägeli; **B.** *Lyngbya contorta* Lemmerm.; **C.** *Oscillatoria perornata* Skuja; **D.** *Lyngbya majuscula* var. *chakiaense* C.B.Rao; **E.** *Lyngbya mesotricha* Skuja; **F.** *Phormidium purpurascens* (Kütz.) Gomont; **G.** *Lyngbya martensiana* Menegh. ex Gomont; **H.** *Phormidium calcicola* N.L.Gardner & **J.** *Oscillatoria tenuis* C.Agardh ex Gomont.

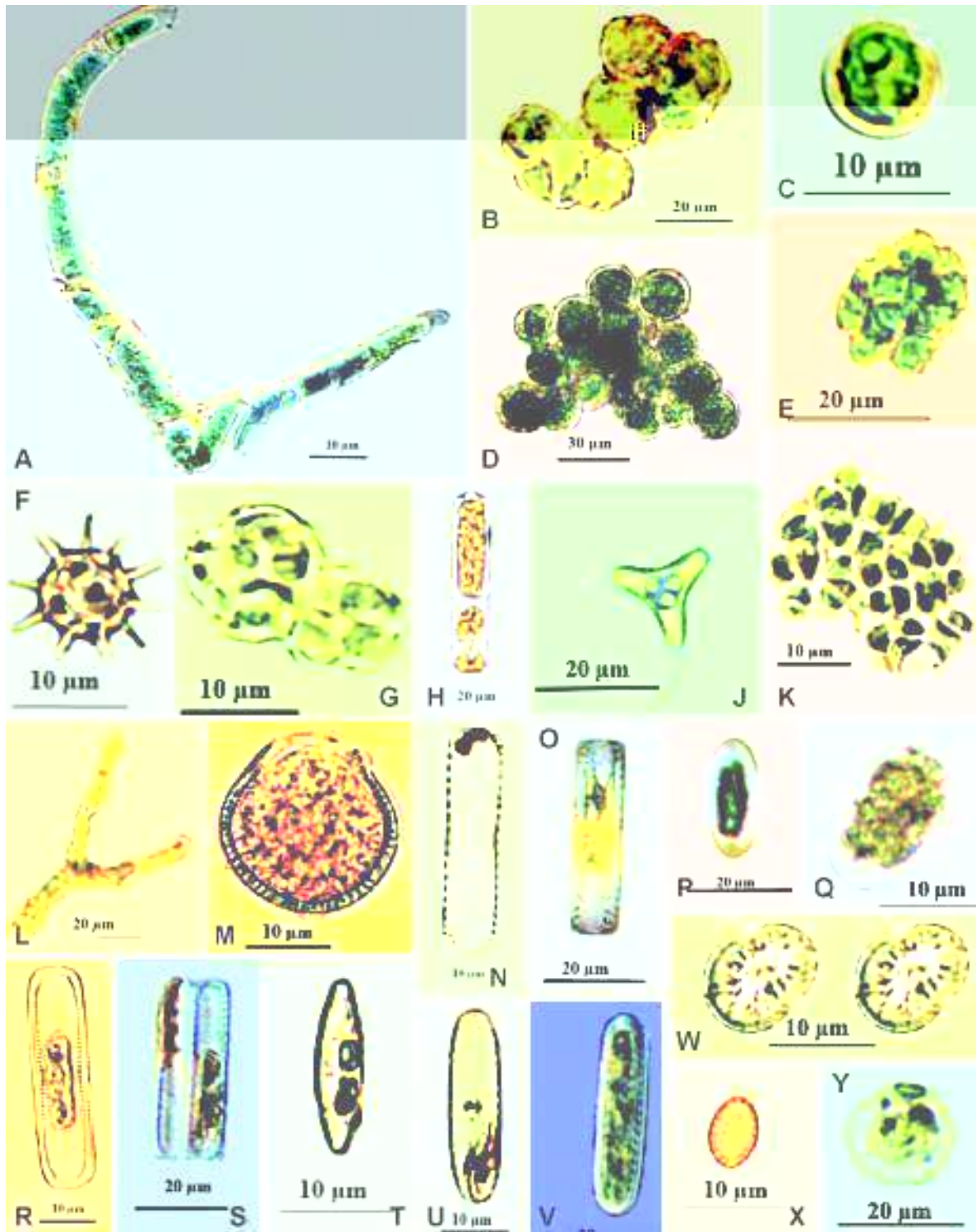




**Fig. 3** Cyanophyceae from *Lodoicea maldivica* (J.E.Gmel.) Pres.: **A.** *Phormidium retzii* (C.Agardh) Kütz. ex Gomont; **B.** *Phormidium tenue* (Menegh.) Gomont; **C.** *Oscillatoria limosa* C.Agardh ex Gomont; **D.** *Scytonema ocellatum* Lyngb. ex Bornet & Flahault; **E.** *Scytonema pseudopunctatum* Skuja; **F.** *Scytonema guyanense* var. *minus* N.L.Gardner & **G.** *Scytonema pseudopunctatum* Skuja.

Table 1. Occurrence of Algae on and around *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) in AJCBIBG, Howrah

S. No.	Name of the Algae	Habitat						
		Parts of <i>Lodoicea maldivica</i>					Soil	Stones
		Tree Trunk			Petiole	Flower		
		Lower part	Middle part	Upper part				
CYANOPHYCEAE								
1.	<i>Chroococcus minutus</i> (Kütz.) Nägeli			+				
2.	<i>Oscillatoria limosa</i> C. Agardh ex Gomont		+					
3.	<i>Oscillatoria perornata</i> Skuja	+						
4.	<i>Oscillatoria tenuis</i> C. Agardh ex Gomont	+						
5.	<i>Phormidium calcicola</i> N. L. Gardner			+				
6.	<i>Phormidium purpurascens</i> (Kütz.) Gomont	+						
7.	<i>Phormidium retzii</i> (C. Agardh) Kütz. ex Gomont		+					
8.	<i>Phormidium tenue</i> (Menegh.) Gomont	+						
9.	<i>Lyngbya contorta</i> Lemmerm.		+					+
10.	<i>Lyngbya majuscula</i> var. <i>chakiaense</i> C.B.Rao	+						
11.	<i>Lyngbya martensiana</i> Menegh. ex Gomont		+					
12.	<i>Lyngbya mesotricha</i> Skuja		+					
13.	<i>Scytonema guyanense</i> var. <i>minus</i> N. L. Gardner		+					
14.	<i>Scytonema ocellatum</i> Lyngb. ex Bornet & Flahault		+					
15.	<i>Scytonema pseudopunctatum</i> Skuja			+				
XANTHOPHYCEAE								
1.	<i>Meringosphaera spinosa</i> Prescott	+						
2.	<i>Monallantus brevicylindrus</i> Pascher			+				
CHRYSTOPHYCEAE								
1.	<i>Apistonema expansum</i> Geitler				+			
2.	<i>Synura splendida</i> Korshikov						+	
BACILLARIOPHYCEAE								
1.	<i>Cyclotella trichonidea</i> Econ.-Amilli							+
2.	<i>Melosira italica</i> (Ehrenb.) Kütz.		+					
3.	<i>Diatoma hyemalis</i> (Roth) Heib	+		+				
4.	<i>Diatoma vulgare</i> Bory	+						
5.	<i>Fragilaria construens</i> (Ehrenb.) Grunow			+			+	
6.	<i>Fragilaria pinnata</i> Ehrenb.	+						
7.	<i>Diploneis ovalis</i> subsp. <i>arctica</i> Lange-Bert. & Genkal							+
8.	<i>Navicula slesvicensis</i> Grunow							+
9.	<i>Pinnularia curticostrata</i> Krammer & Lange-Bert.	+						
10.	<i>Pinnularia humilis</i> Krammer & Lange-Bert.	+						
EUGLENOPHYCEAE								
1.	<i>Trachelomonas pulcherrima</i> Playfair						+	
2.	<i>Trachelomonas volvocina</i> var. <i>compressa</i> Drezep.			+				
CHLOROPHYCEAE								
1.	<i>Pandorina mora</i> (F. Muell.) Bory							+
2.	<i>Protococcus viridis</i> C. Agardh					+		
3.	<i>Chlorococcum humicola</i> (Nägeli) Rabenh.	+						+
4.	<i>Chlorella vulgaris</i> Beij.	+			+	+		+
5.	<i>Treubaria setigera</i> (W. Archer) G. M. Sm.			+				
6.	<i>Crucigenia quadrata</i> Morren			+				
7.	<i>Crucigenia rectangularis</i> (Nägeli) Gay			+				



**Fig. 4** Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Bacillariophyceae and Euglenophyceae from *Lodoicea maldivica* (J.E.Gmel.) Pres. and its surrounding area : **A.** *Scytonema pseudopunctatum* Skuja; **B.** *Protococcus viridis* C. Agardh; **C.** *Chlorella vulgaris* Beij.; **D.** *Chlorococcum humicola* (Nägeli) Rabenh.; **E.** *Pandorina mora* (F. Muell.) Bory; **F.** *Meringosphaera spinosa* Prescott; **G.** *Crucigenia quadrata* Morren; **H.** *Melosira italica* (Ehrenb.) Kütz.; **J.** *Treubaria setigera* (W. Archer) G. M. Sm.; **K.** *Crucigenia rectangularis* (Nägeli) Gay; **L.** *Apistonema expansum* Geitler; **M.** *Synura splendida* Korshikov; **N.** *Diatoma hyemalis* (Roth) Heib; **O.** *Diatoma vulgare* Bory; **P.** *Diploneis ovalis* subsp. *arctica* Lange-Bert. & Genkal; **Q.** *Monallantus brevicylindrus* Pascher; **R.** *Fragilaria construens* (Ehrenb.) Grunow; **S.** *Fragilaria pinnata* Ehrenb.; **T.** *Navicula slesvicensis* Grunow; **U.** *Pinnularia curticostrata* Krammer & Lange-Bert.; **V.** *Pinnularia humilis* Krammer & Lange-Bert.; **W.** *Cyclotella trichonidea* Econ.-Amilli; **X.** *Trachelomonas pulcherrima* Playfair; **Y.** *Trachelomonas volvocina* var. *compressa* Dresep.

Table 2. Algae recorded from on and around *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) in AJCBIBG, Howrah.

Sl. No.	Class	Order	Family	Genus	species	subsp.	var.
1.	Cyanophyceae	2	3	6	13	0	2
2.	Xanthophyceae	1	1	1	2	0	0
3.	Chrysophyceae	2	2	2	2	0	0
4.	Bacillariophyceae	5	7	8	9	1	0
5.	Euglenophyceae	1	1	1	1	0	1
6.	Chlorophyceae	3	5	6	7	0	0

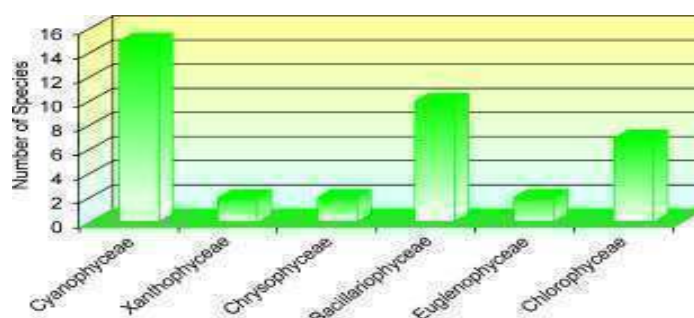


Fig. 5. Number of Algae recorded from different classes.

such as *Protococcus viridis* C.Agardh is only observed on the flower and *Apistonema expansum* Geitler only on leaf petiole. Overall, maximum algal forms were recorded from lower part of the tree trunk followed by upper and middle part probably due to presence of adequate quantity of nutrients, humus and moisture contents. The occurrence of such a large number of algal forms on *Lodoicea maldivica* (J.E.Gmel.) Pres., conserved in the garden for last 116 years is remarkable.

The algal infestation and their genetic stock on and around *Lodoicea maldivica* (J.E.Gmel.) Pres. studied is fascinating and is having applied significance. This is an unique type of finding reported for the first time from a rare slow growing palm species which supported such a vast diversity of algal forms belonging to six Classes on almost all part of the plant body from base to tip of the tree. The outcome of the present investigation is preliminary and needs further detailed study to establish the association as well as succession of different algal forms.

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## ए. जे. सी. बोस भारतीय वनस्पति उद्यान, हावड़ा में अवस्थित लोडोसिया मालद्वीविका ( जे. ई. गेमेल. ) प्रेस. ( द्विनारियल ) पर एवं उसके आस-पास शैवाल विविधता

प्रतिभा गुप्ता

### सार संक्षेप

प्रस्तुत शोधपत्र में आचार्य जगदीशचन्द्र बोस भारतीय वनस्पति उद्यान ( ए.जे.सी.बो.भा.व.उ. ), हावड़ा में अवस्थित लोडोसिया मालद्वीविका ( जे. ई. गेमेल. ) प्रेस. पर एवं उसके आस-पास शैवाल का अध्ययन जुलाई से अक्टूबर, 2010 के मध्य किया गया एवं कुल 38 शैवाल प्राप्त हुए जो कि 6 वर्गों से सम्बद्ध हैं-सायनोफाइसी(15), जेन्थोफाइसी(2), क्राइसोफाइसी(2), बेसीलेरियोफाइसी(10), युग्लीनोफाइसी(2) एवं क्लोरोफाइसी(7)। लोडोसिया मालद्वीविका ( जे. ई. गेमेल. ) प्रेस. पर एवं उसके आस-पास पाये जाने वाले शैवालों का यह प्रथम अध्ययन है।

## GENUS *ISCHAEMUM* L. (POACEAE) IN INDIA

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### ABSTRACT

The present paper presents the Taxonomic treatment of the genus *Ischaemum* in India. In all 56 species have been recognised, of which 43 are endemic to India.

**Keywords :** Endemics, *Ischaemum*, India, Taxonomy.

### ISCHAEMUM L.

L., Sp. Pl. ed. 1. 1049. 1753 & Gen. Pl. ed. 5. 469. 1754; Hack. in DC., Monogr. Phan. 6: 200. 1889; Hook.f., Fl. Brit. India 7: 126. 1896; Prain, Bengal Pl. 1194. 1903; T. Cooke, Fl. Pres. Bombay 2: 957. 1908; Ridl., Fl. Malay. Penin. 5: 199. 1925; Gamble, Fl. Pres. Madras 1917. 1934; Prain, Fl. Trop. Africa 9: 28. 1934; Bor, Fl. Assam 5: 421. 1940; Pilger in Engl. & Prantl, Pflanzenfam. 14e: 125. 1940; Bor, Grass. Burma Ceylon India Pakistan 171. 1960; Clayton & Renvoize, Gen. Gram. 345. 1986. *Schoenanthus* Adans., Fam. Pl. 2: 38. 1763. *Colladoa* Cav., Ic. Pl. 5: 37. t. 460. 1789. *Meoschium* P. Beauv., Ess. Agrost. 111. 1812. *Ischaemopogon* Griseb., Fl. Brit. W. Ind. 560. 1864.

Annuals or perennials; culms erect or creeping. Leaves sessile or rarely petioled, linear or linear-lanceolate or oblong-lanceolate, rounded, cordate or semisagittate at base, acute to acuminate at apex, smooth or scabrid along margins, glabrous or sparsely to densely villous; sheaths often loose; ligule membranous to coriaceous. Inflorescence terminal or axillary racemes. Racemes 2, sometimes 3 or more, digitate or fascicled, rarely solitary, articulate, fragile; joints hairy or glabrous. Spikelets usually in pairs; upper sessile, lower pedicelled, usually awned, 2-flowered; pedicelled spikelets often dissimilar to sessile. Lower floret male or sterile; upper floret bisexual. Sessile spikelets usually ovate-lanceolate, oblong-elliptic or oblong-lanceolate; callus glabrous, bearded, pilose or villous; lower glume usually ovate, oblong, elliptic or lanceolate, acute or acuminate, rarely obtuse, at times bicuspidate, biaristate or rarely 2- to 3-lobed, coriaceous or chartaceous to crustaceous, very rarely membranous, smooth or nodulose or transversely wrinkled, glabrous or hairy; upper glume boat-shaped, dorsally keeled, minutely winged, margins infolded; lower lemma variously shaped, usually acuminate, 3 - 5 - nerved, margins incurved; lower palea usually oblong-lanceolate, elliptic or elliptic-lanceolate, 2-nerved; upper lemma usually oblong, oblong-lanceolate or linear-lanceolate, acute to acuminate, usually notched to lobed, 3 - 7-nerved, awned or rarely awnless; upper palea 2-keeled, usually oblong, oblong-elliptic, oblong-lanceolate or lanceolate, delicate; lodicules 2, cuneate; stamens 3; ovary linear-oblong, style long, stigma linear-oblong, short. Pedicelled spikelets ovate to oblong, awnless; pedicel half as long as sessile spikelet or shorter; lower glume ovate to oblong, coriaceous; upper glume boat-shaped; lower lemma, lower palea, upper lemma and upper palea as in sessile spikelets but smaller with upper lemma notchless and awnless. Lower floret male; upper floret hermaphrodite or male or sterile. Grains oblong or lanceolate, dorsally compressed, embryo reaching middle of grain.

*Type species : Ischaemum muticum* L.

*Distribution:* About 70 species in tropical region of the world, mainly in Asia; 56 species in India. Of these, 43 species are endemic to India confining their distribution to Peninsular India including Maharashtra and North-east India.

*Pollen :* Pollen grains usually 1-ulcerate, spheroidal - ovoid. Sexine about as thick as nexine, pilate or reticulate. Aperture slightly protruding, crassimarginate, operculate (Erdtman, Pollen Morphology and Plant Taxonomy, 1952).

*Ecology :* In India *Ischaemum* L. mainly inhabits tropical areas, while some are found throughout. It thrives best in water-logged and marshy areas.

## KEY TO THE SPECIES

- |   |                                |
|---|--------------------------------|
| 1a. Racemes 3 - 20  | 2                              |
| 1b. Racemes usually 2, very rarely solitary or 3  | 5                              |
| 2a. Inflorescence a fascicle of long peduncled racemes; lowest group of spikelets in threes                                   | 24. <i>I. keralense</i>        |
| 2b. Inflorescence not a fascicle of long peduncled racemes; lowest group of spikelets in pairs                                | 3                              |
| 3a. Margins of lower glume of sessile spikelets narrowly and evenly inturned from base to apex                                | 38. <i>I. pilosum</i>          |
| 3b. Margins of lower glume of sessile spikelets expanded below middle   | 4                              |
| 4a. Lower glume of sessile spikelets 3-nerved, glabrous   | 12. <i>I. duthiei</i>          |
| 4b. Lower glume of sessile spikelets 11 - 13-nerved, villous  | 36. <i>I. nilagiricum</i>      |
| 5a. Spikelets awnless or awns rudimentary (not more than 3 mm) and concealed  | 6                              |
| 5b. Spikelets prominently awned, awns well exerted  | 13                             |
| 6a. Lower glume of sessile spikelets with shallow semilunar pits in lower two third   | 21. <i>I. impressum</i>        |
| 6b. Lower glume of sessile spikelets without such pits  | 7                              |
| 7a. Lower leaves petioled   | 8                              |
| 7b. Lower leaves not petioled   | 11                             |
| 8a. Sessile spikelets 3 - 4 mm long   | 4. <i>I. bolei</i>             |
| 8b. Sessile spikelets 6 - 7.5 mm long   | 9                              |
| 9a. Lower glume of sessile spikelets without side nodules but with transverse wrinkles in lower half                          | 53. <i>I. vembnadense</i>      |
| 9b. Lower glume of sessile spikelets with side nodules at base, connected by ridges   | 10                             |
| 10a. Lower glume of pedicelled spikelets with a broad wing on one margin; racemes paired                                      | 51. <i>I. travancorensis</i>   |
| 10b. Lower glume of pedicelled spikelets without a broad wing on one margin; racemes usually solitary                         | 20. <i>I. huegelii</i>         |
| 11a. Racemes concealed or hardly exerted from spathe, c. 3.5 cm long  | 34. <i>I. muticum</i>          |
| 11b. Racemes well-exserted from spathe, 4 - 10 cm long  | 12                             |
| 12a. Keel of upper glume of sessile spikelets minutely winged at apex; nodes glabrous; pedicels c. 1 mm long                  | 23. <i>I. jayachandranii</i>   |
| 12b. Keel of upper glume of sessile spikelets not winged; nodes hairy; pedicels c. 2.5 mm long                                | 15. <i>I. flumineum</i>        |
| 13a. Margins of lower glume of sessile spikelets expanded in lower half   | 14                             |
| 13b. Margins of lower glume of sessile spikelets narrowly and evenly inflexed from base to apex                               | 23                             |
| 14a. Keel of upper glume of sessile spikelets winged at or above middle   | 15                             |
| 14b. Keel of upper glume of sessile spikelets not winged  | 20                             |
| 15a. Keel of lower glume of sessile spikelets not winged  | 16                             |
| 15b. Keel of lower glume of sessile spikelets narrowly or broadly winged in upper half  | 17                             |
| 16a. Joints of racemes with a 3 - 3.5 mm long tooth-like projection on inner side   | 49. <i>I. thomsonianum</i>     |
| 16b. Joints of racemes without such tooth-like projection on inner side   | 2. <i>I. agasthyamalayanum</i> |
| 17a. Wings of lower glume of sessile spikelets broad, often auriculate; lower glume less than 6 mm long                       | 18                             |
| 17b. Wings of lower glume of sessile spikelets very narrow, lower glume 6 - 8 mm long   | 19                             |
| 18a. Callus long, glabrous; upper glume of both spikelets dorsally broadly winged   | 30. <i>I. lisboae</i>          |
| 18b. Callus short, bearded; upper glume of both spikelets narrowly winged   | 22. <i>I. indicum</i>          |
| 19a. Racemes very hairy; leaves cuneate at base   | 28. <i>I. lacei</i>            |
| 19b. Racemes glabrous; leaves rounded at base   | 17. <i>I. heterotrichum</i>    |
| 20a. Lower glume of sessile spikelets even in texture throughout, herbaceous - chartaceous                                    | 18. <i>I. hirtum</i>           |
| 20b. Lower glume of sessile spikelets subcoriaceous below, herbaceous above   | 21                             |
| 21a. Joints of racemes with a 3 - 5 mm long tooth-like projection on inside; glumes glabrous; sessile spikelets 4 - 6 mm long | 22                             |
| 21b. Joints of racemes without such a projection; glumes hairy on upper half; sessile spikelets 3 - 4 mm long                 | 50. <i>I. timorensis</i>       |
| 22a. Lower leaves petioled, petioles up to 5 cm long  | 56. <i>I. zeylanicum</i>       |



- 22b. Lower leaves not petioled 49. *I. thomsonianum*
- 23a. Lower leaves or in some cases upper ones distinctly petioled; leaf-base usually sagittate or deeply cordate or rarely shallowly cordate, rounded or cuneate at base 24
- 23b. Lower leaves or upper ones not petioled; leaf- base usually narrow, cuneate or rarely rounded or shallowly cordate 35
- 24a. Pedicels more than one-third the length of sessile spikelets 25
- 24b. Pedicels less than one-third the length of sessile spikelets 29
- 25a. Leaves deeply cordate or sagittate or cordate at base; lower glume of pedicelled spikelets not broadly winged on one side 26
- 25b. Leaves cuneate or narrowly rounded at base; lower glume of pedicelled spikelets broadly winged on one or both sides 27
- 26a. Sessile spikelets 3.5 - 4 mm long 31. *I. malabaricum*
- 26b. Sessile spikelets 6 - 7 mm long 28
- 27a. Lower glume of pedicelled spikelets broadly and more or less uniformly winged throughout on both sides 37. *I. pappinisseriense*
- 27b. Lower glume of pedicelled spikelets broadly winged only on one side 30
- 28a. Nodes glabrous; awn of upper lemma of sessile spikelets 1.7-2.2 cm; anthers 3-3.5 mm long 16. *I. glabriglaucum*
- 28b. Nodes villous; awn of upper lemma of sessile spikelets 1.3-1.5 cm long; anthers 1.25-2.5 mm long 39. *I. pushpangadanii*
- 29a. Upper glume of sessile spikelets narrowly winged at apex; culms creeping and mat forming 40. *I. quilonense*
- 29b. Upper glume of pedicelled spikelets not winged at apex; culms not creeping and mat forming 8. *I. commutatum*
- 30a. Lower glume of sessile spikelets broadly winged on one margin 31
- 30b. Lower glume of sessile spikelets not broadly winged on one margin 33
- 31a. Lower glume of sessile spikelets with distinct side nodules separated by deep or shallow furrows 32
- 31b. Lower glume of sessile spikelets with or without side nodules; side nodules when present, not separated by deep or shallow furrows 3. *I. barbatum*
- 32a. Culms diffuse or erect; lower glume of sessile spikelets with 4 - 6 side nodules separated by deep furrows 42. *I. rangacharianum*
- 32b. Culms creeping, rooting at nodes, mat forming; lower glume of sessile spikelets with 3 or rarely 4 side nodules separated by shallow furrows 14. *I. fischeri*
- 33a. Joints of racemes linear-clavate 10. *I. dalzellii*
- 33b. Joints of racemes distinctly turbinate 34
- 34a. Sessile spikelets very narrow in comparison to size, 6 - 8 x c. 1.5 mm; pedicelled spikelets very shortly pedicelled; side nodules interlocking 44. *I. ritchiei*
- 34b. Sessile spikelets not very narrow, 6 - 7.5 x c. 2 mm; pedicelled spikelets prominently pedicelled; side nodules not interlocking 36
- 35a. Joints of rachis, pedicels and callus densely white woolly; lower glume crustaceous 29. *I. lanatum*
- 35b. Joints of rachis, pedicels and callus not woolly; lower glume chartaceous 47. *I. semisagittatum*
- 36a. Pedicels more than one third the length of sessile spikelets 37
- 36b. Pedicels less than one third the length of sessile spikelets 48
- 37a. Lower glume of sessile spikelets with two tufts of hairs on margins about the middle 38
- 37b. Lower glume of sessile spikelets without such tufts of hairs on margins about the middle 39
- 38a. Pedicelled spikelets imperfect, awnless 11. *I. diplopogon*
- 38b. Pedicelled spikelets well developed, awned (awn c. 4 mm long) 41. *I. raizadae*
- 39a. Upper glume of sessile spikelets with a tuft of hairs in upper third 25. *I. kingii*
- 39b. Upper glume of sessile spikelets without such a tuft of hairs in upper third 40
- 40a. Lower glume of pedicelled spikelets not winged on one margin 41
- 40b. Lower glume of pedicelled spikelets winged on one margin 42
- 41a. Leaves linear, 10 - 15 x 0.5 - 0.8 cm, cuneate or rounded at base , not deeply cordate or sagittate 38. *I. pilosum*

- 41b. Leaves triangular, ovate-lanceolate or lanceolate, 1 - 10 x 0.5 - 1.5 cm,  
deeply cordate or sagittate at base 31. *I. malabaricum* 43
- 42a. Lower glume of sessile spikelets narrowly winged above the middle 44
- 42b. Lower glume of sessile spikelets not winged above the middle 44
- 43a. Leaves broadly auriculate at base, tubercle-based hairy on both surfaces 19. *I. hubbardii*
- 43b. Leaves cuneate at base, glabrous 27. *I. kumarakodiense*
- 44a. Keel of upper glume of sessile spikelets minutely winged at least towards apex 45
- 44b. Keel of upper glume of sessile spikelets not winged 47
- 45a. Upper glume of sessile spikelets humped in middle 13. *I. elimalayanum*
- 45b. Upper glume of sessile spikelets not humped in middle 46
- 46a. Lower glume of sessile spikelets smooth or wrinkled with few side nodules,  
usually hairy; leaves up to 20 x 1 cm; culms not robust 7. *I. kannanorensis*
- 46b. Lower glume of sessile spikelets with several side nodules  
connected by sharp ridges, glabrous; leaves 10 - 60 x 1 - 2 cm; culms robust 35. *I. nairii*
- 47a. Lower glume of sessile spikelets unequally and narrowly winged,  
faintly transversely wrinkled; upper glume of sessile spikelets humped below;  
culms up to 1.5 m; nodes bearded 1. *I. abrahamii*
- 47b. Lower glume of sessile spikelets not winged or transversely wrinkled;  
upper glume of sessile spikelets not humped; culms up to 30 cm; nodes glabrous 48. *I. tadulingamii*
- 48a. Lower glume of sessile spikelets coriaceous or rarely chartaceous 49
- 48b. Lower glume of sessile spikelets crustaceous below 57
- 49a. Sessile spikelets 8 - 10 mm long 26. *I. koenigii*
- 49b. Sessile spikelets not more than 7 mm long 50
- 50a. Leaves linear or linear-lanceolate, up to 40 cm long, narrowed towards  
base, base rounded or cuneate 51
- 50b. Leaves ovate-lanceolate, lanceolate or triangular, not narrowed towards base,  
base shallowly to deeply cordate or sagittate 54
- 51a. Lower glume of sessile spikelets broadly and auriculately winged on one side  
towards apex; lower glume of pedicelled spikelets broadly winged on one margin 32. *I. mangaluricum*
- 51b. Lower glume of sessile spikelets narrowly winged towards apex or not winged;  
lower glume of pedicelled spikelets not broadly winged 52
- 52a. Pedicelled spikelets prominent and well developed 53
- 52b. Pedicelled spikelets minute or rudimentary 55
- 53a. Lower glume of sessile spikelets densely villous with silky hairs 32. *I. molle*
- 53b. Lower glume of sessile spikelets not densely villous 3. *I. barbatum*
- 54a. Sessile spikelets 3 - 4 mm long 43. *I. rauii*
- 54b. Sessile spikelets more than 4 mm long 56
- 55a. Racemes in fascicles up to 7.5 cm long, well exerted From spatheolate; spikelets rudimentary 46. *I. santapaui*
- 55b. Racemes not in fascicles up to 3.5 cm long, shortly exerted from spatheolate; minute c. 4 mm long 55. *I. yadavii*
- 56a. Lowest group of spikelets in threes, one awned, others awnless 9. *I. copeanum*
- 56b. Lowest group of spikelets in pairs 58
- 57a. Leaves 1 - 4 cm long; pedicelled spikelets awnless 52. *I. tumidum*
- 57b. Leaves up to 10 cm long; pedicelled spikelets awned 6. *I. calicutense*
- 58a. Sessile spikelets 8-9 mm long 5. *I. bombaiense*
- 58b. Sessile spikelets up to 6 mm long 59
- 59a. Leaves lanceolate, cordate at base 54. *I. vembnadense*
- 59b. Leaves linear-lanceolate, cuneate at base 60
- 60a. Lower glumes of sessile spikelets oblong-ovate, sharply ridged;  
pedicelled spikelets at times rudimentary 45. *I. rugosum*
- 60b. Lower glume of sessile spikelets obscurely ridged; pedicelled spikelets well developed 54. *I. wayanadense*

**1. *Ischaemum abrahamii*** Ravi, Mohanan & Rajesh in Bot. Bull. Acad. Sin. 42: 225. 2001.

*Type* : India : Kerala; Manathumangalam,  $\pm$  50 m, 15 Dec. 1996, Ravi 33027 (*Holo* : TBGT; *Iso* : CAL, MH, KFRI).

Robust perennials; culms tufted, up to 1.5 m long; nodes ciliate. Leaves linear to linear-elliptic, *c.* 40 x 1.2 cm, cuneate, rounded, acuminate; sheaths *c.* 15 cm long; ligules triangular-ovate, up to 6 mm long. Racemes 2, up to 10 cm long; joints clavate, triquetrous, *c.* 3 mm long, densely pilose on angles. Sessile spikelets oblong-elliptic to lanceolate, 5 - 6 mm long; callus ciliate, *c.* 1 mm long; lower glume oblong-elliptic, 4.5 - 5.5 mm long, coriaceous, laterally keeled, unequal, narrowly winged, 11 - 13-nerved; upper glume boat-shaped, 4.75 - 5.75 mm long, margins inrolled, humped, 5 - 7-nerved; lower lemma linear, 4.5 - 5 mm long, 3-nerved, margins ciliate towards apex; lower palea linear-elliptic, 4.5 - 5 mm long, hyaline, 2-nerved; upper lemma 4 - 4.5 mm long, deeply cleft, awned from sinus; awn geniculate, 1.6 - 2 cm long with 6 - 9 mm long column; upper palea oblong-lanceolate, *c.* 4 mm long, 2-nerved. Pedicelled spikelets: pedicels clavate, 2 - 3 mm long, pilose; lower glume laterally keeled, incurved at margins, winged on one side; upper glume 4 - 5 mm long, coriaceous, keeled, 5 - 7-nerved; lower lemma, lower palea and upper palea similar to sessile spikelets; upper lemma lanceolate, 4 - 4.5 mm long, 3-nerved, shortly notched and imperfectly awned; awn up to 4 mm long. Lodicules 2, *c.* 0.5 mm long. Stamens 3; anthers *c.* 2 mm long. Ovary *c.* 0.5 mm long; style *c.* 2 mm long; stigma *c.* 2.5 mm long.

*Flowering & Fruiting* : Oct. - Jan.

*Ecology* : Along roadsides and water channels, in hilly tracts.

*Distribution* : INDIA : Kerala (Malappuram). Endemic.

*Note* : *I. abrahamii* is allied to *I. elimalayanum* Sreek. & al., but differs in having robust habit, longer and densely woolly racemes, thicker joints of rachis, pedicel and lower glume of both spikelets.

**2. *Ischaemum agasthyamalayanum*** Sreek., Janarth. & A.N. Henry in J. Bombay Nat. Hist. Soc. 84(3): 643. 1987; Sreek. & V.J. Nair, Fl. Kerala - Grass. 121. 1990.

*Type* : India : Kerala; Thiruvananthapuram, western slopes of Agasthyamalai, 1800 m, 6.10.1973, J. Joseph 446340 (*Holo* : CAL).

Perennials; culms up to 80 cm tall, stoloniferous, rarely erect; nodes bearded or glabrous. Leaves elliptic to linear-lanceolate, 2 - 10 x 0.5 - 1 cm, cordate at base, acuminate at apex, densely hairy; sheaths keeled; ligules ovate, 2 - 4 mm long, membranous. Racemes 2, rarely 3, 3 - 5 cm long, densely hairy; joints turbinate, 2.5 - 3 mm long, hairy. Sessile spikelets oblong-lanceolate, 7 - 8 mm long, densely villous, awned; callus bearded; lower glume ovate-lanceolate, 5 - 6 mm long, 3-lobed at apex or rarely bicuspidate, chartaceous, 11 - 13-nerved, hairy; upper glume boat-shaped, 6 - 8 mm long, shortly bifid, acuminate, 3 - 5-nerved, margins infolded, arista 2 - 3 mm long; lower lemma ovate-oblong, *c.* 5 mm long, 3 - 5-nerved, ciliate at apex; lower palea elliptic-lanceolate, 2-nerved, margins infolded; upper lemma awned, *c.* 5 mm long, lobes acute; awn 1.2 - 1.5 cm long; column 5 - 6 mm long; upper palea oblong-lanceolate, 2-nerved. Lower floret male; upper floret bisexual. Pedicelled spikelets oblong-lanceolate, 6 - 7 mm long, awn sometimes present; pedicels *c.* 2 mm long, villous; lower glume ovate-lanceolate, 5 - 6 mm long, 9 - 11-nerved, dorsally villous; upper glumes, lemmas and florets as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : In grassy hill slopes and grasslands.

*Distribution* : INDIA : Kerala (Agasthyamalai). Endemic. Rare.

**3. *Ischaemum barbatum*** Retz., Obs. Bot. App. 6: 35. 1791; Bor in Kew Bull. 15: 411. 1961; Sreek. & V.J. Nair, Fl. Kerala - Grass. 123. 1990; U. Shukla, Grass. N.E. India 102. 1996; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 515. 1996. *I. aristatum* L. var. *barbatum* Hack. in DC., Monogr. Phan. 6: 203. 1889; Hook.f., Fl. Brit. India 7: 127. 1896. *I. aristatum* L. var. *imbricatum* sensu J. N. Mitra, Fl. Pl. E. India 1: 204. 1958, non Hook.f. 1896. *I. imbricatum* (Hack.) Stapf ex Ridl., Fl. Malay. Penin. 5: 200. 1925. *I. goebellii* Hack. in Oest. Bot. 51: 149. 1901.

Annuals or perennials; culms 60 - 120 cm tall, erect, tufted; nodes glabrous. Leaves linear-lanceolate, 10 - 30 x 0.5 - 1 cm, narrowed at base; sheaths loose; ligules 3 - 5 mm long, coriaceous. Racemes 2, appressed, 6 - 15 cm long; joints clavate-turbinate, 5 - 6 mm long. Sessile spikelets oblong-lanceolate, 6 - 7 mm long, awned; callus glabrous; lower glume ovate, 6 - 7 mm long, acute, 13 - 15-nerved, with or without 4 - 6 side nodules, tip narrowly winged on one side; upper glume 6 - 7 mm long, boat-shaped, keeled on dorsal side, margins infolded; lower lemma elliptic-lanceolate, c. 6 mm long, 3 - 5-nerved; lower palea elliptic-lanceolate, hyaline, 2-keeled, 2-nerved; upper lemma with 8 - 10 mm long awn; upper palea oblong, c. 4.5 mm long, 2-nerved, sprinkled with wart like dots. Lower floret male; upper floret bisexual. Pedicelled spikelets ovate-oblong, 5 - 6 mm long, awnless; pedicels clavate, c. 2 mm long; lower glume 5 - 6 mm long, 9 - 11-nerved, broadly winged on one margin; upper glume c. 5 mm long, boat-shaped, 5 - 7-nerved; lemmas and paleas as in sessile spikelets but smaller. Lower floret male.

*Flowering & Fruiting* : July - Dec.

*Ecology* : Along roadsides in moist places.

*Distribution* : INDIA: E. & N.E. India, Karnataka and Tamil Nadu; CHINA, HONGKONG, JAPAN, MALAY PENINSULA, NEPAL and SRI LANKA.

*Note* : Robust leafy grass probably used as fodder; growing wild in Meghalaya.

**4. *Ischaemum bolei*** Almeida in Indian For. 98: 236. 1972; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 515. 1996.

*Type* : India : Maharashtra; Ratnagiri Dt., Savantwadi, 18.11.1970, M.R. Almeida 1735 (Holo : BLAT).

Perennials; culms up to 80 cm tall, erect, or decumbent, branched at nodes. Leaves linear, 4 - 12 x 0.8 - 1 cm, cordate to sagittate at base, acuminate, bulbous hairy, upper leaves sessile; petioles up to 4 mm long in lower leaves; sheaths rounded, 4 - 6 cm long, glabrous; ligules 2 - 4 mm long, hairy at margins. Racemes 2, c. 4 cm long, compressed. Sessile spikelets oblong-lanceolate, 3 - 4 mm long, acute, awnless; lower glume lanceolate, c. 3.5 mm long, margins inturned, dorsal surface with 2 - 4 nodules, many nerved; upper glume boat-shaped, 3 - 4 mm long, 1-nerved, upper half ciliate along margins; lower lemma lanceolate, c. 3 mm long, obtuse to acute, hyaline; upper lemma acute, upper half of margins laciniate, hyaline; upper palea acute, hyaline. Lower floret male; upper floret bisexual. Pedicelled spikelets with broad wing on one margin; glumes, lemmas and paleas as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : Grows on grassy hill slopes.

*Distribution*: INDIA : Maharashtra. Known only from the original collection. Endemic to Sawantwadi in Ratnagiri.

*Note* : *I. bolei* is closely allied to *I. huegelii* but differs in having smaller sessile spikelets. It also resembles *I. barbatum* in having 2 - 3 nodules on margins of lower glume.

**5. *Ischaemum bombaiense*** Bor in J. Bombay Nat. Hist. Soc. 49: 165. 1950 & Grass. Burma, Ceylon India Pakistan 178. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 515. 1996.

*Type* : India : Maharashtra; Khandala, Blatter 9904 (K).

Annuals; culms up to 30 cm tall, slender, glabrous. Leaves linear-lanceolate, c. 12 x 7 cm, narrowed at base, acuminate at apex, hairy on both surfaces, shortly petioled; sheaths villous, loose; ligules 2-3 mm long, scarious. Racemes 2; joints triangular, c. 7 mm long, ciliate at one angle. Sessile spikelets oblong, 8 - 9 mm long, acute; lower glume c. 8 mm long, coriaceous, rugose, with 3 - 4 stout ridges, noduled on margins; upper glume boat-shaped, c. 8 mm long, keeled above, 3-nerved; lower lemma oblong-elliptic, c. 8 mm long, acute, hyaline; lower palea smaller; upper lemma c. 6 mm long, cleft halfway down with geniculate awn; awn c. 2 cm long, twisted; upper palea c. 6 mm long, hyaline. Lower floret male; upper floret bisexual. Stamens 3, c. 3 mm long; styles 2; stigma plumose, purple. Pedicelled spikelets c. 7.5 mm long; pedicels c. 1.5 mm long, villous on outer margin; lower glume c. 7.5 mm long, broadly winged on one margin; upper glume boat-shaped, c. 7 mm

long, with 2 - 3 prominent nodules on dorsal surface; lower lemma and palea elliptic-lanceolate, hyaline; upper lemma and palea as in lower floret. Lower floret empty; upper floret female.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : Along margins of lakes.

*Distribution* : INDIA : Madhya Pradesh (Sagar), Maharashtra (Mumbai, Pune), Rajasthan (Chittorgarh) and Uttar Pradesh. Endemic. Rare.

*Note* : Closely allied to *I. rugosum* but differs in having large sessile spikelets and overall robust habit.

**6. *Ischaemum calicutense*** Sreek., V.J. Nair & N.C. Nair in J. Econ. Taxon. Bot. 4: 1007. 1983, '*calicutensis*'; Sreek. & V.J. Nair, Fl. Kerala - Grass.125. 1991.

*Type*: India : Kerala; Calicut Dt., Pokkunnamalai near Nanminola, ± 850 m, 29.10.1981. *P.V. Sreekumar* 71803 ( *Holo*: CAL).

Perennials; culms 25 - 80 cm tall, creeping; nodes hairy or glabrous. Leaves lanceolate, 2-10 x 0.7-1.4 cm, cordate at base, acuminate at apex; sheaths *c.* 1.5 cm long, nearly glabrous; ligules ovate, 1-2 mm long, membranous. Racemes 2, 4 - 6 cm long, villous, enclosed in spathe; joints turbinate, 3 - 4 mm long, villous. Sessile spikelets ovate-lanceolate, *c.* 5 mm long, awned; lower glume ovate, *c.* 5 mm long, coriaceous, villous, hairs *c.* 1.5 mm long, smooth or with few obscure nodules; upper glume boat-shaped, *c.* 5 mm long, 5-nerved, winged at apex; lower lemma lanceolate, 4 - 5 mm long, 5 - 7-nerved, margins infolded; lower palea delicate, 2-nerved; upper lemma 3 - 3.5 mm long, notched, lobes acute, 3-nerved; awns 2 - 2.5 cm long, column *c.* 1 cm long; upper palea oblong, delicate, 2-nerved. Lower floret male or bisexual with rudimentary pistil; upper floret bisexual. Pedicelled spikelets oblong, 5 - 6 mm long, awned; pedicels 1-1.5 mm long, villous; lower glume oblong-lanceolate, 4.5 - 5 mm long, 5 - 7-nerved, villous; upper glume boat-shaped, keel rounded, villous; lower lemma lanceolate, *c.* 4.5 mm long, delicate, 3 - 5 -nerved, margins infolded; lower palea oblong-lanceolate, 2-nerved, glabrous; upper lemma *c.* 3.5 mm long, notched, lobes acute; awn 1.2-1.5 cm long, column *c.* 5 mm long; upper palea oblong, *c.* 2.5 mm long, rounded at apex. Lower floret male, often with rudimentary pistil; upper floret bisexual.

*Flowering & Fruiting* : Fl. & Fr. : Oct.- Dec.

*Ecology* : Along dry rocky hill slopes.

*Distribution* : INDIA : Kerala ( Calicut). Endemic. Rare.

**7. *Ischaemum kannanoreense*** Sreek., V.J. Nair & N.C. Nair in J. Econ. Taxon. Bot. 4(3): 1009. 1983, '*kannanorensis*'; Sreek. & V.J. Nair, Fl. Kerala - Grass.127. 1991.

*Type* : India : Kerala; Cannanore Dt., Paramba, On way to Bendudka, ± 150 m, 16<sup>th</sup> Oct. 1981, *P.V. Sreekumar* 71713 ( *Holo*: CAL; *Iso*: K, MH).

Perennials; culms up to 60 cm tall, erect. Leaves, lanceolate, 3 -10 x 0.4-0.6 cm, rounded or cordate at base, long acuminate at apex, villous or nearly glabrous; sheaths 2 - 6 cm long, keeled, glabrous; ligules oblong, 2 - 3 mm long. Racemes 2, 2 - 5 cm long, enclosed in a spathe; joints clavate, 2.5-3.5 mm long, villous on dorsal side and along margins. Sessile spikelets ovate-oblong, *c.* 5 mm long, hairy or glabrous, awned; lower glume ovate-oblong, *c.* 4 mm long, smooth or wrinkled with few nodules, hairy or glabrous, 11 - 13-nerved; upper glume boat-shaped, 4 - 5 mm, 2 - keeled, 3 -nerved, margins incurved, glabrous; lower lemma oblong-lanceolate, *c.* 3.5 mm long, 3-nerved; lower palea 3 - 4 mm long, delicate, 2-nerved; upper lemma notched, *c.* 3.5 mm long, lobes acute, faintly 3-5-nerved, glabrous; awn 1.5 - 2 cm long, column *c.* 1 cm long; upper palea oblong, *c.* 0.5 mm long; style *c.* 1 mm long; stigma *c.* 1 mm long, feathery. Pedicelled spikelets ovate, 3.5 - 5 mm long, usually unawned; pedicels *c.* 2 mm long, villous; lower glume ovate, 4 - 5 mm long, winged on one side; upper glume lanceolate, 3.5 - 4.5 mm long, glabrous; lower lemma and palea similar to sessile spikelets; upper lemma ovate-lanceolate, 3 - 5-nerved, glabrous. Lower floret male; upper floret bisexual.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : In marshy places.

*Distribution*: INDIA: Kerala (Cannanore). Endemic. Rare.

- 8. *Ischaemum commutatum*** Hack. in DC., Monogr. Phan. 6: 209. 1889; Hook.f., Fl. Brit. India 7: 131. 1896; C.E.C. Fisch., in Gamble, Fl. Pres. Madras 1722. 1934; Bor, Grass. Burma Ceylon India Pakistan 178. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 129. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 516. 1996.

*Type* : Sri Lanka (Ceylon), *Thwaites* 2625 (CAL).

Perennials; culms up to 1 m tall, trailing or erect. Leaves ovate or oblong-lanceolate, 5 - 15 x 1 - 1.5 cm, cordate at base, acuminate at apex; lower leaves sessile or sometimes petioled; petioles 2-6 cm long, hairy to glabrous; sheaths slightly keeled; ligules ovate, *c.* 1.5 mm long. Racemes 2, rarely 3, 2.5 - 6 cm long; joints turbinate, densely ciliate on one angle. Sessile spikelets oblong, 5-6 mm long, awned; lower glume oblong, obtuse to acute, smooth, glabrous, 11 - 13-nerved, margins infolded; upper glume boat-shaped, faintly 3-nerved, ciliate and rounded at apex; lower lemma oblong-lanceolate, *c.* 5 mm long, hyaline, 3 - 4-nerved; lower palea oblong-lanceolate, *c.* 4 mm long, delicate, 2-nerved; upper lemma *c.* 5 mm long, notched, acute, ciliate along margins, awned; awn 1 - 1.5 cm long; upper palea oblong, hyaline, delicate. Lower floret male; upper floret bisexual. Pedicelled spikelets ovate, *c.* 5 mm long, acute, awnless; lower glume ovate, *c.* 4.5 mm long, acute, winged on margins; upper glume ovate-lanceolate, dorsally keeled; florets male; lower lemma and palea as in sessile spikelets, but smaller; upper lemma entire, awnless.

*Flowering & Fruiting* : June - Sept.

*Ecology*: In marshy agricultural fields and forest edges.

*Distribution* : INDIA : Karnataka, Kerala, Maharashtra, Tamil Nadu; SRI LANKA.

*Note* : Leafy plant used as fodder.

- 9. *Ischaemum copeanum*** Sreek., V.J. Nair & N.C. Nair in J. Bombay Nat. Hist. Soc. 82: 390. 1985; Sreek. & V.J. Nair, Fl. Kerala - Grass. 130. 1991.

*Type* : India : Kerala; Cannanore Dt., Cherkala,  $\pm$  250 m, 24.11.1981, *P.V. Sreekumar* 71838 (*Holo* : CAL).

Annuals; culms up to 40 cm tall, creeping. Leaves ovate-lanceolate, 2 - 5 x 0.5 - 1 cm, rounded or cordate at base, acuminate at apex; sheaths up to 5 cm long, striate, glabrous; ligules ovate, 1 - 2 cm long. Racemes 2; peduncles 2-3 cm long, exserted; joints clavate, villous along margins and dorsal side. Lowest group of spikelets in threes, two are unawned. Unawned sessile spikelets linear-oblong, *c.* 5 mm long, single flowered, floret male; lower glume lanceolate, silky villous towards base, margins infolded. Awned sessile spikelets ovate, *c.* 4.5 mm long, acute; lower glume ovate-oblong, 11 - 13-nerved, narrowly winged on one side, scabrid towards apex; upper glume boat-shaped or lanceolate, 3-nerved, keeled; lower lemma oblong-lanceolate, *c.* 4 mm long, delicate, 3 - 5-nerved; lower palea 2-keeled, glabrous; upper lemma *c.* 3.5 mm long, notched, lobes acute; awn 1 - 1.5 cm long, geniculate, column 4 - 6 mm long, bristle pale; upper palea oblong, glabrous. Lower floret male; upper floret bisexual. Stamens 1.5 - 3 mm long, filaments short; ovary oblong, *c.* 0.5 mm long; style *c.* 1 mm long; stigma *c.* 1.5 mm long, feathery. Pedicelled spikelets oblong-lanceolate, 4 - 4.5 mm long, unawned; pedicels *c.* 1 mm long, villous; lower glume linear-oblong, *c.* 4.5 mm long, villous in lower half; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Nov. - Dec.

*Ecology* : Along banks of streams.

*Distribution* : INDIA : Kerala (Cannanore). Endemic. Rare.

*Note* : *I. copeanum* is closely allied to *I. keralense* except for the former having racemes 2 in number on each peduncle whereas the latter has racemes in fascicle of 5 - 8 from spathe. The types of both these species have been collected from the same locality and also from the same habitat. Detailed study is needed to differentiate these two taxa for which more collections are required. At present only the type specimen is available.

- 10. *Ischaemum dalzellii*** Stapf ex Bor in Kew Bull. 1951: 448. 1952 & Grass. Burma Ceylon India Pakistan 178. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 132. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 516. 1996.

*Type* : India : Karnataka; North Kanara, 25.10.1854, *W.A. Talbot* 738 (*Iso* : CAL).

Annuals or perennials; culms 30 -100 cm tall, tufted, creeping or trailing. Leaves linear-lanceolate, 4 -15 x 1 - 1.5 cm, cordate at base, long acuminate at apex, lower leaves distinctly petioled; petioles up to 5 cm long; ligules ovate, acute, membranous. Racemes 2, slender, 3 - 6 cm long; joints linear-clavate, 3 - 4 mm long, ciliate along margins. Sessile spikelets oblong, 5 - 7 mm long, awned; callus bearded; lower glume linear-oblong, coriaceous below with 3 - 5 side nodules, 7 - 9-nerved, villous along margins in upper half; upper glume boat-shaped, 5 - 6 mm long, 3 - 5-nerved, keeled in lower half; lower lemma oblong-lanceolate, delicate, hyaline, 3-nerved; lower palea elliptic-lanceolate, delicate, 2-nerved; upper lemma c. 4 mm long, deeply notched, awned; awn 1.5 - 2.5 cm long; upper palea oblong, delicate. Lower floret male or bisexual with a rudimentary pistil; upper floret bisexual. Pedicelled spikelets smaller, oblong-lanceolate, c. 6 mm long, awned or awnless; pedicels c. 2 mm long, densely ciliate, glumes and florets as in sessile spikelets.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : On rocky hill slopes.

*Distribution* : INDIA : Karnataka, Kerala and Maharashtra. Endemic. Rare.

*Note* : This can easily be distinguished from other Indian *Ischaemum* species by its long-petioled lower leaves with hastate base, shining, linear-clavate or clavate joints and pedicels and narrowly oblong-lanceolate spikelets.

**11. *Ischaemum diplopogon*** Hook.f., Fl. Brit. India 7: 129. 1896; Bor, Grass. Burma Ceylon India Pakistan 178. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 516. 1996.

*Type* : India : Bombay (near Bhorkus), Oct. 1892, *Woodrow* s.n. (*Iso*: CAL).

Annuals; culms 30 - 45 cm long, branched from base and upwards; nodes glabrous; internodes long. Leaves linear-lanceolate, 7 - 15 x 0.5 - 1.5 cm, narrowed at base, acuminate at apex, dark green, shining above; nerves 3 - 4 pairs; sheaths spathiform, glabrous; ligule oblong, glabrous. Racemes 2, compressed, 2.5 - 5 cm long; peduncles many, filiform from upper spathiform sheaths; joints and pedicels half the length of pedicelled spikelets. Sessile spikelets c. 6 mm long; lower glume oblong, c. 5 mm long, shortly bicuspidate, obscurely nerved, margins narrowly incurved with two tufts of hairs on margins about the middle, bulged in lower third; upper glume ovate, c. 5 mm long, subacute, 3-nerved, shortly bifid with white awn, c. 5 mm long; lower lemma linear-oblong, 1-nerved; upper lemma 4 mm long, bifid at apex, lobes hyaline, awn 1 - 6 mm long; upper palea small, oblong. Lower floret male, upper floret bisexual. Pedicelled spikelets awnless, often imperfect; lower glume elliptic, 2-cuspidate.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : On wet rocks in streams.

*Distribution* : INDIA : Madhya Pradesh, Maharashtra and Rajasthan. Endemic. Rare.

**12. *Ischaemum duthiei*** Stapf ex Bor in Kew Bull. 1950: 188. 1950 & Grass. Burma Ceylon India Pakistan 178. 1960; G.P. Roy, Grass. Madhya Pradesh 102. 1984.

*Type* : India : Bihar; Neterhat, 100 m, Oct. 1918, *H.H. Haines* 5896 (*Iso* : CAL). Neterhat, Nov. 1898, *H.H. Haines* 128 (*Para* : CAL).

Perennials; culms c. 80 cm tall, branched; nodes densely hairy. Leaves linear-lanceolate, c. 20 x 2 cm, attenuate at base, acute at apex, pubescent beneath, glabrous above; ligules 2.5 - 3 mm long, membranous. Racemes 5 - 12, 3 - 7 cm long, subdigitate, hairy; joints c. 2 mm long, hairy on one angle. Sessile spikelets c. 6 mm long; callus c. 1 mm long, densely pilose; lower glume lanceolate, 4 - 5.5 mm long, bicuspidate, winged on either side at apex, glabrous; upper glume lanceolate, 4 - 5 mm long, acuminate, rounded at base, compressed above, 5-nerved; lower lemma elliptic, c. 3.5 mm long, acute; lower palea 2-nerved, as long as lemma; upper lemma c. 3.5 mm long, hyaline, notched, bilobed, awned; awn 7 - 8 mm long; upper palea lanceolate, hyaline, equal to lemma. Lower floret male; upper floret bisexual. Stamens 3; anthers c. 2.5 mm long. Ovary oblong; stigma feathery. Pedicelled spikelets c. 5.5 mm long; lower glume flattened, lanceolate, c. 4.5 mm long, acute, dorsally pilose, many nerved; upper glume c. 4.5 mm long, rounded at base, keeled towards apex, aristate; lemmas, paleas and florets as in sessile spikelets.

*Flowering & Fruiting* : Nov. - Feb.

*Ecology* : In marshy habitats.

*Distribution* : INDIA : Bengal, Bihar, Himachal Pradesh and Madhya Pradesh. Endemic.

**13. *Ischaemum elimalayanum*** Sreek., V.J. Nair & N.C. Nair in Sreek. & V.J. Nair, Fl. Kerala - Grass. 134, 459. 1991.

*Type* : India : Kerala; Cannanore Dt., Elimala,  $\pm$  300 m, 20 Oct. 1981, *P.V. Sreekumar* 71773 (*Holo* : CAL; *Iso* : K, MH).

Tufted perennials; culms up to 1 m tall, erect; nodes villous. Leaves linear-lanceolate, 6-20 x 0.5 - 1 cm, acuminate; lower ones narrowed at base, upper ones rounded; sheaths 5 - 15 cm long, keeled, densely pilose; ligules ovate, 3 - 6 mm long, acute, membranous. Racemes 2, 4 - 10 cm long, stout, hairy; peduncle shortly exserted; joints linear-clavate, 2.5 - 3 mm long, villous along margins and dorsal angles. Sessile spikelets elliptic, 5 - 5.5 mm long, awned; callus bearded; lower glume ovate or oblong, *c.* 4.5 x 1.5 - 2 mm, acute, crustaceous with 4 - 5 side nodules, deeply wrinkled, 9 - 11-nerved, margins inturned; upper glume boat-shaped, 4.5 - 5 x 1 - 1.5 mm, humped in middle, tip minutely winged, sparsely hairy; lower lemma oblong-lanceolate, 4 - 4.5 x 1 - 1.5 mm, 3-nerved, ciliate in upper half; lower palea delicate, hyaline, 2-nerved, glabrous; upper lemma 3 - 3.5 mm long, notched, margins ciliolate at upper half, 3-nerved; awn 1.2 - 1.5 cm long, geniculate; upper palea 2.5 - 3 mm long, hyaline, 2-keeled, 2-nerved, glabrous. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 1.5 mm long. Ovary oblong; style *c.* 1 mm long; stigma feathery. Pedicelled spikelets oblong, 4 - 4.5 mm long, unawned; pedicels 2.5 - 5 mm long, densely hairy; lower glume *c.* 5 mm long, broadly winged on one margin, scabrid, 7 - 9-nerved; upper glume lanceolate, *c.* 4 mm long, keel rounded, 3 - 5-nerved, margins infolded; lower lemma oblong, acute, 3-nerved, ciliate; palea lanceolate, upper lemma 3 - 3.5 mm long, 3 - 5-nerved, glabrous; palea and florets as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Jan.

*Ecology* : Along grassy hill slopes.

*Distribution* : INDIA : Kerala (Cannanore). Endemic.

**14. *Ischaemum fischeri*** Ravi & Kiran Raj in Bot. Bull. Acad. Sin. 42: 227. 2001. *I. rangacharianum* C.E.C. Fisch. in Kew Bull. 1933. p.p. quoad specim. (Paratypus) *V. Narayanaswamy* 1743 (CAL).

*Type* : India : Kerala; Thiruvananthapuram Dt., Palode - TBGRI Campus,  $\pm$  150 m, 12 Feb. 1998, *Ravi* 36706 (*Holo* : TBGT; *Iso* : CAL, MH, KFRI).

Perennials; culms creeping, mat forming, up to 75 cm long. Leaves elliptic to lanceolate, up to 15 cm long, lower ones tapering into pseudo- petioles, acute to acuminate at apex; sheaths up to 8 cm long, keeled; ligules triangular-ovate, 2 - 5 mm long. Racemes 2, up to 10 cm long; joints oblong-clavate, triquetrous, 3 - 5 mm long. Sessile spikelets oblong-elliptic, 5 - 7 mm long, callus ciliate; lower glume oblong-elliptic, 4 - 6 mm long, laterally keeled, 2 - 4-nodulose in lower half, laterally winged unequally, 11 - 13-nerved; upper glume boat-shaped, 4.5 - 6.5 mm long, keeled, narrowly winged, 5 - 7-nerved; lower lemma elliptic-lanceolate, 3 - 5 mm long, 3-nerved, incurved; lower palea elliptic-lanceolate, 3 - 5 mm long, hyaline, 2-nerved, narrowly winged; upper lemma oblong-elliptic, 3 - 4.5 mm long, deeply cleft, awned; awn geniculate, up to 1.5 cm long, column *c.* 6.5 cm long; upper palea oblong-elliptic, 3 - 5 mm long, 2-nerved, incurved. Pedicelled spikelets : pedicels 1 - 2 mm long, triquetrous; lower glume oblong-elliptic, 4 - 6.5 mm long, laterally keeled, winged on one side, 1 - 3 nodulose, notched at apex, 11 - 13-nerved; upper glume, lower lemma lower palea and upper palea as in sessile spikelets; upper lemma oblong-elliptic, 3 - 4 mm long, shortly bifid or imperfectly awned; awn usually shorter. Lodicules 2, *c.* 0.7 mm long. Stamens 3; anthers 2 - 3 mm long. Ovary *c.* 0.5 mm long; styles *c.* 2 mm long; stigma *c.* 2 mm long.

*Flowering & Fruiting* : Oct. - April

*Ecology* : Forms extensive mats over hill slopes.

*Distribution* : INDIA : Kerala (Ernakulam, Kollam, Pathanamthitta, Thiruvananthapuram). Endemic.

*Note* : *I. fischeri* is closely allied to *I. rangacharianum* but differs in perennial habit, creeping and mat forming culms, 1 or 2 peduncles and 2 or 3 to 4-nodulose lower glumes of sessile spikelets.



**15. *Ischaemum flumineum*** Bor in Kew Bull. 1949: 572. 1950 & Grass. Burma Ceylon India Pakistan 178. 1960.

*Type* : India : Maharashtra; Bombay, Jog, 28.4.1939, *N.L. Bor* 11390 (K, DD).

Perennials with long wiry, fibrous roots; culms woody, branched, erect, glabrous, smooth; nodes hairy. Leaves narrow, elliptic, *c.* 10 x 5 cm, acuminate at apex, attenuate at base, nearly glabrous or sparsely hairy above, margins scabrous. Racemes 2, *c.* 4 - 5 cm long, exserted on long peduncle; joints *c.* 3 mm long, thin, hairy on one side. Sessile spikelets lanceolate or narrowly elliptic, *c.* 5 mm long; callus *c.* 1 mm long; lower glume broadly ovate, *c.* 4 mm long, margins ciliate, apex bimucronate, coriaceous below, chartaceous above; upper glume *c.* 4 mm long, rounded at base, keeled on both sides towards apex, 3-nerved, glabrous, aristate; arista 2 - 3 mm long, hairy; lower lemma elliptic, *c.* 4 mm long, acuminate, 5-nerved, hyaline; lower palea as long as lemma, hyaline, 2-nerved; upper lemma oblong, 2 - 2.5 mm long, bilobed, rounded on dorsal side, notched at tip, 3-nerved, awned; awn 1 - 2 mm long, geniculate, twisted. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 1.2 mm long. Ovary *c.* 0.5 mm long, oblong; style *c.* 1 mm long; stigma feathery. Pedicelled spikelets lanceolate, *c.* 5 mm long, compressed laterally; pedicels *c.* 2.5 mm long; lower glume lanceolate, *c.* 5 mm long, keeled, 5-nerved, hairy on dorsal surface, aristate; arista *c.* 1.5 mm long; upper glume *c.* 4.5 mm long, rounded at base, keeled above, densely pilose; arista *c.* 2.5 mm long; lower lemma lanceolate, *c.* 3.5 mm long, hyaline, glabrous; palea hyaline, 2-nerved; upper lemma oblong, *c.* 2.5 mm long, notched; awn *c.* 1 cm long, geniculate; column *c.* 5 mm long, twisted. Lower and upper florets male.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : In crevices of rocks near marshy beds of rivers.

*Distribution* : INDIA : Andaman Islands, Maharashtra and Tamil Nadu. Endemic.

*Note* : Apparently resembles *I. thomsonianum* and *I. timorensis* in having wiry tufted habit and bicuspidate arista in lower glume of sessile spikelets.

**16. *Ischaemum glabriglaucum*** Sunil in Candollea 60(2): 387. 2005.

*Type* : INDIA : Kerala, Vazhachal, Trichur distr., 300 m, 4.10.1999, *Sunil* 2235 (holo; K; ISO; CALI, BRIT, L)

Annual. Culms tufted, erect to diffuse, up to 170 cm long, young internodes glaucous towards the nodes; nodes glabrous. Leaves all along the culm; sheath 3-9 cm long, ligule coriaceous, 1-6 mm long, obtuse or notched. Leaves linear-lanceolate or elliptic-lanceolate, narrowed towards base, membranous, sparsely bulbous-pilose above and below, upper blades ovate-lanceolate, base deeply cordate-hastate, nearly to sessile, margins scabrous, apex acuminate, coriaceous, glabrous. Inflorescence terminal or axillary with (1)2-5 peduncles; racemes 2, 3-8 cm long, glabrous towards base and densely long-villous upwards; joints of rachis crustaceous, 2.5-4 mm long densely long-villous. Sessile spikelets : Lower ones unawned or rudimentary awn, others awned, 5-6.5 mm long, linear-lanceolate. Lower glume linear-lanceolate, 5-6 x 1.5 mm apex obtuse, hyaline-membranous thickly coriaceous, 13-nerved, incurved at margins, laterally 1-3 nodulous in the lower portion of the raceme, densely long-villous in the lower half. Upper glume up to 6 x 1 mm linear-lanceolate, keeled, thickly coriaceous. Lower lemma hyaline, 5-6 x 1.25-1.5 mm, linear-lanceolate, 3-nerved. Lower palea linear-lanceolate, hyaline, 5-5.5 x 1-1.25 mm, apex acute, 2-nerved. Upper lemma linear-oblong or elliptic 4-4.5 x 0.75-1 mm; awns at sinus, (15)17-22 mm long. Upper palea linear-lanceolate, hyaline, 4-4.5 x 1 mm, acute, incurved on margins. Pedicelled spikelets : linear-elliptic to lanceolate, up to 6 x 2 mm. Lower glume linear-lanceolate or linear-elliptic, 5-6 x 1.5-2 mm thickly coriaceous, 9-11 nerved, bifid at apex, 1-2-nodulose, glabrous. Upper glume, lower lemma and lower palea similar to those of the sessile spikelets. Upper lemma linear-lanceolate, hyaline; awn 4 mm long, apex acute to acuminate, 4-5 mm long. Upper palea similar to sessile spikelets but smaller. Lodicules 2, *c.* 1 x 0.5 mm, apex truncate, lobed. Stamens 3; anthers 3-3.5 mm long. Ovary 0.5-0.75 x *c.* 0.5 mm, ovate; styles 1-1.5 mm long; stigmas *c.* 2 mm long, feathery. Grains 2-2.5 x 0.75-1 mm, ellipsoid, slightly trigonous, apiculate.

*Flowering & Fruiting* : Oct. - Jan.

*Ecology* : Growing on open rocky slopes near Vazahachal river at 300 m altitude.

*Distribution* : INDIA : Kerala

*Note* : This species is allied to *I. pushpangadanii* but distinguished by its glabrous nodes, glaucous young culms, much shorter pedicels, longer awn of upper lemma of sessile spikelets and anthers.

**17. *Ischaemum heterotrichum*** Hack. in DC., Monogr. Phan. 6: 220. 1889; Hook.f., Fl. Brit. India 7: 134. 1896; Bor, Grass. Burma Ceylon India Pakistan 179. 1960.

*Type* : India : Nicobar, *Jelink* s.n. (Vind).

Perennials; culms 40 - 60 cm tall, slender, prostrate, glabrous. Leaves linear-lanceolate, 5 - 15 x 0.7 - 3 cm, glabrous, rounded at base, margins undulate, scabrid; sheaths compressed, keeled; ligules short, truncate, ciliate. Racemes 2, 4.5 - 6.5 cm long, stout, erect, glabrous; joints bearded. Sessile spikelets 8 - 10 mm long; callus bearded at base; lower glume lanceolate, 6 - 8 mm long, acute, membranous, 4-nerved, margins involute below the middle, narrowly winged on upper half; upper glume subcoriaceous, mucronate at apex, margins ciliate, keel winged above; lower lemma short, ovate, acute, chartaceous, 3-nerved, ciliate; lower palea membranous; upper lemma broadly oblong, ciliolate, notched, awned; awn confluent with lemma. Lower floret male; upper floret bisexual. Pedicelled spikelets c. 6 mm long; lower glume winged at middle towards apex, glabrous; upper glume not dorsally winged; lemmas and paleas as in sessile spikelets except for lower lemma 5-nerved with lanceolate acuminate ciliate lobes.

*Flowering & Fruiting* : Sept. - Jan.

*Ecology* : Along seashores, often forming mats in coconut plantations.

*Distribution* : INDIA : Andaman & Nicobar Islands; MASCARENE ISLAND.

**18. *Ischaemum hirtum*** Hack., in DC., Monogr. Phan. 6: 228. 1889, p.p.; Hook.f., Fl. Brit. India 7: 135. 1896; Bor, Grass. Burma Ceylon India Pakistan 179. 1960; U. Shukla, Grass. N.E. India 104. 1996.

*Type* : India : Meghalaya; Khasia, 2000 m; *Hook. & Thomson*, "*Spodiopogon* no. 13", (*Iso* : CAL).

Perennials; culms 30 - 60 cm tall, unbranched, ascending from a decumbent base. Leaves linear-lanceolate, c. 20 x 0.5 cm, acuminate, hairy on both surfaces, membranous; sheaths loose, glabrous below, hirsute above, striate; ligules truncate. Racemes 2, occasionally 3, up to 11 cm long; joints c. 4 mm long, pilose on outer edge. Sessile spikelets 6 - 7 mm long; lower glume lanceolate, chartaceous, hairy in upper half, unequally bicuspidate at apex, 6 - 9-nerved, margins expanded below middle; upper glume c. 7 mm long including arista, 3 - 5-nerved, scabrid on keel and on back; lower lemma oblong-lanceolate, c. 5 mm long, acuminate, membranous, faintly 3-nerved; lower palea oblong, c. 4 mm long, hyaline; upper lemma ciliolate, awn slender, confluent with lemma; upper palea as long as lemma. Lower floret male or sterile; upper floret hermaphrodite. Pedicelled spikelets smaller, reduced to glumes.

*Flowering & Fruiting* : June - Nov.

*Ecology* : In waste places near flowing water.

*Distribution* : INDIA : Assam, Bihar, Meghalaya and Orissa BANGLADESH, MALAY PENINSULA and SRI LANKA.

**19. *Ischaemum hubbardii*** Bor in Indian For. Rec. (Bot.) 1(3): 98. 1938 & Grass. Burma Ceylon India Pakistan 179. 1960; U. Shukla, Grass. N.E. India 104. 1996.

*Type* : India : Meghalaya; Cherrapunjee, *N.L. Bor* 21368 (*Iso* : ASSAM).

Perennials; culms up to 90 cm tall, compressed at base, covered with old leaf-sheaths; nodes glabrous or bearded. Leaves linear-lanceolate, 5 - 14 x 1 - 1.5 cm, tubercled hairs on both surfaces, broadly auricled at base, acute at apex; sheaths loose, glabrous. Racemes 2, 4 - 8 cm long; joints c. 6 mm long, pilose on outer edge. Sessile spikelets 6 - 7 mm long; lower glume oblong, c. 6 mm long, obtuse, slightly convex on back, narrowly winged on margins above the middle; upper glume with a narrow wing below the apex; lower lemma c. 6 mm long, hyaline; lower palea shorter than lemma; upper lemma c. 5 mm long, cleft at apex, awned; awn

c. 2 cm long, geniculate, twisted. Lower floret male; upper floret bisexual. Pedicelled spikelets usually smaller, reduced to glumes; lower floret male if present; upper floret absent.

*Flowering & Fruiting* : Aug. - Oct.

*Ecology* : In marshy places in hilly areas.

*Distribution* : INDIA : Assam and Meghalaya. Endemic.

- 20. *Ischaemum huegelii*** Hack. in DC., Monogr. Phan. 6: 252. 1889; Hook.f., Fl. Brit. India 7: 139. 1896; Bor, Grass. Burma Ceylon India Pakistan 179. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 517. 1996. *I. inerme* Stapf ex Bor in Kew Bull. 1951: 448. 1952.

*Type* : India : Bassahir, *Huegel* (Vienna).

Perennials; culms slender, glabrous, branched below, rooting at lower nodes, purple. Leaves 10 - 25 x 1 - 2 cm, linear, flat, flaccid, upper sessile, cordate-lanceolate, lower ones shortly petiolate. Racemes mostly unbranched, solitary, 3.5 - 5 cm long, stout; joints clavate, dorsally convex. Sessile spikelets 6.5 - 7.5 mm long, awnless; lower glume oblong, obtuse, coriaceous towards base, with 3 - 4-nodules on margin connected by ridges, glabrous or dorsally ciliate, margins narrowly inflexed; upper glume ovate, deeply keeled; lower lemma oblong, hyaline, glabrous; lower palea membranous; upper lemma linear-lanceolate, acute, 1-nerved, awnless; upper palea linear-lanceolate. Lower floret male; upper floret bisexual. Pedicelled spikelets awnless; pedicels less than 1/3 the length of sessile spikelets; lower glume linear-lanceolate, flat, acuminate, many nerved; upper glume, lemma and florets as in sessile spikelets.

*Flowering & Fruiting* : Aug. - Dec.

*Ecology* : In wet places.

*Distribution* : INDIA : Maharashtra (Mumbai). Endemic. Rare.

- 21. *Ischaemum impressum*** Hack. in DC., Monogr. Phan. 6: 210. 1889; Hook.f., Fl. Brit. India 7: 132. 1896; Bor, Grass. Burma Ceylon India Pakistan 180. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 517. 1996.

*Type* : Asia : *Huegel* 4018 (K).

Annuals; culms 20 - 30 cm tall, erect, branching upwards, nearly glabrous. Leaves oblong to linear-lanceolate, 5 - 10 x 0.8 - 1.8 cm, lower narrower, petiolate, hairy on both surfaces, margins thickened, scaberulous, crenulate; sheaths compressed, glabrous; ligules oblong. Racemes 2, 2 - 5 cm long; callus short, bearded; joints stout, forked at apex. Sessile spikelets 6 - 8 mm long; lower glume ovate, 6 - 7 mm long, hairy with depression in lower third on dorsal surface, concave in upper half, margins inturned; upper glume obtuse, chartaceous, ciliate, humped in center of dorsal surface, keel winged, wing auricled; lower lemma oblong-lanceolate, 3-nerved, ciliate; lower palea oblong; upper lemma short, glabrous, cleft above middle, unawned or very shortly awned in the cleft; upper palea oblong-obtuse, glabrous. Lower floret male; upper floret bisexual. Pedicelled spikelets c. 5 mm long, obliquely ovoid; pedicels more than 1/3 the length of sessile spikelets; lower glume obtuse, glabrous, many nerved, winged on one margin; upper glume 7-nerved; upper lemma mucronate; lower lemma and florets as in sessile spikelets.

*Flowering & Fruiting* : Aug. - Dec.

*Ecology* : In marshy places.

*Distribution* : INDIA : Gujarat, Maharashtra and Rajasthan; PAKISTAN.

- 22. *Ischaemum indicum*** (Houtt.) Merr. in J. Arn. Arbor. 19: 320. 1938; Bor, Grass. Burma Ceylon India Pakistan 180. 1960; G.P. Roy, Grass. Madhya Pradesh 103. 1984; Sreek. & V.J. Nair, Fl. Kerala - Grass. 136. 1991; U. Shukla, Grass. N.E. India 104. 1996; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 517. 1996. *Phleum indicum* Houtt., Nat. Hist. (2): 13, 198. t. 90. f. 2. 1782 var. *wallichii* (Hack.) Bor, Grass. Burma Ceylon India Pakistan 180. 1960. *Ischaemum ciliare* Retz., Obs. Bot. 6: 36. 1791; Hook.f., Fl. Brit. India 7: 133. 1896. *I. ciliare* Retz. var. *wallichii* Hack. in DC., Monogr. Phan. 6: 227. 1889. *I. aristatum* L., Sp. Pl. 1049. 1753; Hook.f., Fl. Brit. India 7: 226. 1896. *I. aristatum* L. var. *wallichii* (Hack.) Bor in Indian For. Rec. (Bot.) 1: 3, 98. 1938.

Annuals; culms 20 - 90 cm long, slender, creeping, rooting at nodes; nodes nearly glabrous to hairy. Leaves linear-lanceolate, 0.5 - 8 x 0.2 - 0.5 cm, acute, rounded at base, glabrous to densely hairy or villous, entire or undulate along margins; sheaths keeled; ligules ovate, acute, membranous. Racemes 1 - 3, 2 - 8 cm long; joints turbinate, 1 - 2 m long, densely villous. Sessile spikelets ovate-oblong, 4.5 - 6.5 mm, awned; callus bearded; lower glume ovate-oblong, 4 - 5 x 1 - 1.5 mm, hairy or glabrous, notched, 7 - 9-nerved, broadly winged on both sides in upper half, margins long ciliate; upper glume boat-shaped, 4 - 5 x 1.5 - 2 mm, aristate, arista 1 - 3 mm long, dorsally keeled, minutely winged; lower lemma ovate-lanceolate, 3 - 4 x 1 - 1.5 mm, 3-nerved; lower palea elliptic, 3 - 3.5 x 0.5 - 1 mm, chartaceous, 2-keeled, 2-nerved, margins infolded; upper lemma 3 - 4 x 1.5 - 2 mm, notched, awned, 3-nerved; awn 8 - 15 mm long, column 3 - 5 mm; upper palea oblong, 3 - 3.5 x c. 1 mm, delicate, 2-nerved. Lower floret male; upper floret bisexual. Stamens 3; anthers 1.5 - 2 mm long. Ovary oblong, c. 0.5 mm long; style 1 - 1.5 mm long; stigma 1 - 1.5 mm long. Pedicelled spikelets ovate, 5 - 6 mm long, awned; pedicels 1.5 - 2 mm long, villous; lower glume ovate-lanceolate, 9 - 11-nerved, winged on one margin, densely villous in upper half; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Aug. - Nov.

*Ecology* : In marshy places.

*Distribution* : INDIA : Andaman & Nicobar Islands, Assam, Bihar, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan and Tripura; BANGLADESH, JAVA, MYANMAR, PHILIPPINES and SINGAPORE.

#### KEY TO THE VARIETIES

- |   |                              |
|---|------------------------------|
| 1a. Pores distinct on ventral surface of racemes; spikelets 4.5-6.5 mm long   | 22.1. var. <i>indicum</i>    |
| 1b. Pores indistinct on ventral surface of racemes; spikelets 5.5-6.5 mm long | 2                            |
| 2a. Lower glume of sessile spikelets hairy; leaves glabrous or pubescent      | 22.3. var. <i>wallichii</i>  |
| 2b. Lower glume of sessile spikelets glabrous; leaves densely hairy           | 22.2. var. <i>longipilum</i> |

#### 22.1. var. *indicum*

#### KEY TO THE SUBVARIETIES

- |   |                                      |
|---|--------------------------------------|
| 1a. Culms slender, creeping   | 2                                    |
| 1b. Culms stout, erect  | 3                                    |
| 2a. Lower glume of sessile spikelets smooth towards apex; acuminate   | 22.1.1. subvar. <i>indicum</i>       |
| 2b. Lower glume of sessile spikelets scrobiculate towards apex; acute | 22.1.3. subvar. <i>scrobiculatum</i> |
| 3a. Leaves densely villous with erect hairs                           | 22.1.4. subvar. <i>villosum</i>      |
| 3b. Leaves nearly glabrous  | 22.1.2. subvar. <i>malacophyllum</i> |

**22.1.1. subvar. *indicum*** : Sreek. & V.J. Nair, Fl. Kerala - Grass. 137. 1991. *Phleum indicum* Houtt., Nat. Hist. 11. 13: 198. t.90, f.2. 1782. *I. ciliare* Retz. var. *prorepens* Hack. in DC., Monogr. Phan. 6: 226. 1889; Hook.f., Fl. Brit. India 7: 134. 1896.

Type : India : Karnataka; Hook.f. & Thomson s.n. (CAL).

Culms slender. Leaves glabrous to sparsely hairy. Pores distinct on ventral surface of racemes; joints densely hairy. Spikelets 4.5 - 5 mm long; lower glume of sessile spikelets smooth towards apex, acuminate; prominently 7 - 9-nerved, broadly winged on either side in upper half, wings auriculate.

*Flowering & Fruiting* : Jan. - Sept.

*Ecology* : Along paddy fields and roadsides.

*Distribution* : Throughout India including Andaman & Nicobar Islands. Common.

**22.1.2. subvar. *malacophyllum*** (Hochst. ex Steud.) Bor, Grass. Burma Ceylon India Pakistan 180. 1960. *Andropogon malacophyllus* Hochst. ex Steud., Syn. Pl. Glum. 1: 372. 1854. *Ischaemum ciliare* Retz. var. *malacophyllum* (Hochst. ex Steud.) Hack. in DC., Monogr. Phan. 6: 226. 1889; Hook.f., Fl. Brit. India 7: 134. 1896.

*Types* : India : Tamil Nadu; Nilgiri, *Hohenacker* 917 (CAL); Terai, *W. Gomez*, Oct. 1827, *Wallich* 8852 (CAL).

Culms tall, stout. Leaves pubescent or nearly glabrous. Pores distinct on ventral surface of racemes. Sessile spikelets *c.* 5 mm long; lower glume broadly winged towards apex.

*Flowering & Fruiting* : July - Dec.

*Ecology* : In marshy places of hotter parts of India.

*Distribution* : INDIA : Assam, Bihar, Tamil Nadu and West Bengal.

- 22.1.3.** subvar. **scrobiculatum** (Nees ex Steud.) Bor, Grass. Burma Ceylon India Pakistan 180. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 138. 1991. *Spodiopogon scrobiculatus* Nees ex Steud., Syn. Pl. Glum. 1: 373. 1854. *Ischaemum ciliare* Retz. var. *scrobiculatum* (Nees ex Steud.) Hack. in DC., Monogr. Phan. 6: 226. 1889; Hook.f., Fl. Brit. India 7:134. 1896.

Culms slender, creeping. Leaves puberulous. Joints of racemes sparsely hairy; pores distinct on ventral surface of racemes. Sessile spikelets *c.* 5 mm long; lower glume of sessile spikelets scrobiculate towards base, acute at apex, narrowly winged, keel of upper glume ciliate.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : Along roadsides, hill slopes and wastelands.

*Distribution* : INDIA: Kerala, Meghalaya and Tamil Nadu; SRI LANKA and TAIWAN.

- 22.1.4.** subvar. **villosum** (Nees) Bor, Grass. Burma Ceylon India Pakistan 180. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 138. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 519. 1996. *Spodiopogon villosum* Nees in Hook. & Arn., Bot. Beech. Voy.242. 1838. *Ischaemum ciliare* Retz. var. *villosum* (Nees) Hack. in DC., Monogr. Phan. 6: 227. 1889; Hook.f., Fl. Brit. India 7: 134. 1896.

*Type* : India : Chanda, *Duthie*, s.n. (CAL).

Culms stout, tufted, erect. Leaves elliptic-lanceolate, acuminate, longer than other subvarieties, densely villous with erect hairs; sheaths keeled, densely villous.

*Flowering & Fruiting* : Aug. - Jan.

*Ecology* : In open grasslands, hillslopes and rocky places; usually in drier areas.

*Distribution* : INDIA : Karnataka, Kerala, Madhya Pradesh, Maharashtra and Tamil Nadu; SRI LANKA.

- 22.2.** var. **longipilum** (Hack.) Bor, Grass. Burma Ceylon India Pakistan 181. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 140. 1991; *I. ciliare* Retz. var. *longipilum* Hack. in DC., Monogr. Phan. 6: 227. 1889.

Culms stoloniferous, creeping; nodes nearly glabrous. Leaves petiolate, densely covered with tubercled hairs. Pores indistinct on the ventral surface of racemes. Lower glume glabrous with broad auriculate wings towards apex.

*Flowering & Fruiting* : Nov. -Dec.

*Ecology* : Along hill slopes.

*Distribution* : INDIA : Kerala. Rare; SRI LANKA.

- 22.3.** var. **wallichii** (Hack.) Bor, Grass. Burma Ceylon India Pakistan 180. 1960. *Ischaemum ciliare* Retz. var. *wallichii* Hack. in DC. Monogr. Phan. 6: 227. 1889.

*Type* : Sylhet, *Wallich* 8860B (CAL)

Culms erect, tufted; nodes densely villous. Leaves glabrous or hairy. Pores indistinct on ventral surface of racemes. Sessile spikelets 5 - 6 mm long; lower glume slightly notched at apex, densely pilose, winged on either side.

*Flowering & Fruiting* : Aug. - Sept.

*Ecology* : In open grass-lands and hill slopes.

*Distribution* : INDIA : Assam, Kerala, Manipur, Meghalaya and Tripura; BANGLADESH.

- 23. *Ischaemum jayachandranii*** R. Ansari, V.S. Ramach. & Sreek. in Curr. Sci. 53(3): 151. 1984; Sreek. & V.J. Nair, Fl. Kerala - Grass.140. 1991.

*Type* : India : Kerala; Cannanore, Nileshtar, 175 m, 29.1.1979, *V.J. Nair* 59981 (*Holo* : CAL).

Stoloniferous perennials; culms *c.* 50 cm tall, slender; nodes glabrous. Leaves elliptic-lanceolate, 3 - 12 x 0.2 - 0.6 cm, lower ones narrowed at base, upper ones rounded, margins minutely serrulate; sheaths 4 - 10 cm long, striate, glabrous; ligules ovate, *c.* 2.5 mm long. Racemes 2, 4 - 10 cm long, exerted from spathe; joints *c.* 4 x 2 mm, coriaceous, glabrous. Sessile spikelets oblong-lanceolate, 5 - 6 x *c.* 2 mm, unawned; callus glabrous; lower glume oblong-lanceolate, *c.* 5 x 1.75 mm, 11 - 13-nerved, margins incurved; upper glume boat-shaped, *c.* 5.5 x 2 mm, sharply keeled, minutely winged at apex, 3 - 5-nerved; lower lemma lanceolate, *c.* 5 - 6 x *c.* 1.5 mm, margins incurved; lower palea 4 - 5 x 1 - 1.5 mm, 2-nerved, glabrous; upper lemma ovate-lanceolate, 4.5 - 5 x 1.5 - 2 mm, entire or rarely notched, 5-nerved, median nerve prominent, prolonged into a rudimentary awn when notched, wart like outgrowth in upper half; upper palea glabrous. Lower floret male; upper floret bisexual. Stamens 3; anthers 1.5 - 2 mm long; filaments short. Ovary oblong, *c.* 0.5 x 0.3 mm; style 1.5 - 2 mm long; stigma *c.* 1 mm long, feathery. Pedicelled spikelets oblong, *c.* 5 - 5.5 mm long, acute, unawned; pedicels *c.* 1 mm long; lower glume ovate, 5 - 5.5 x *c.* 1.75 mm, acute, narrowly winged on one margin; upper glume lanceolate, 4.5 - 5 mm long, keel rounded, coriaceous; florets as in sessile spikelets.

*Flowering & Fruiting* : Dec. - Jan.

*Ecology* : In marshy places.

*Distribution* : INDIA : Kerala (Cannanore). Endemic.

- 24. *Ischaemum keralense*** Sreek., V.J. Nair & N.C. Nair in Adansonia 2: 135, t.1. 1985, '*keralensis*'; Sreek. & V.J. Nair, Fl. Kerala - Grass. 142. 1991.

*Type* : India : Kerala; Cannanore, Cherkala, ± 250 m, 24.11.1981, *P.V. Sreekumar* 71839 (*Holo* : CAL).

Creeping annuals; culms 20 - 50 cm tall; upper nodes villous. Leaves lanceolate, 4 - 10 x 0.5 - 1.5 cm, acuminate, cordate at base, lower leaves petioled; petioles 0.5 - 1.5 cm long; sheaths 2 - 5 cm long, glabrous; ligules ovate, 1 - 1.5 mm long. Racemes in fascicles of 5 - 8 long peduncles from a spathe, 2 - 5 cm long; joints *c.* 4 mm long, villous. Lowest group of spikelets in threes, two pedicelled, awnless, one sessile, awned. Sessile spikelets oblong-lanceolate, 4 - 5 x *c.* 1.25 mm; callus bearded; lower glume oblong, 4.5 - 5 mm long, 9 - 11-nerved, with few side nodules, margins incurved; upper glume boat-shaped, 4.5 - 5 x *c.* 1.75 mm, keeled, 3-nerved, hairy on upper half on dorsal side; lower lemma ovate-lanceolate, 3 - 5-nerved, margins infolded, ciliate in upper half; lower palea elliptic-lanceolate, 4 - 5 mm long, 2-nerved, glabrous; upper lemma 4 - 4.5 mm, notched, lobes acuminate, 3-nerved; awn 1.2 - 1.6 cm long, geniculate, column 4 - 6 mm long, brown, scabrid; upper palea linear, 2-nerved, wart like dots towards apex. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 1.5 mm long (2 - 3 mm long in bisexual florets). Ovary *c.* 0.5 mm long; style *c.* 1.5 mm long, slender; stigma *c.* 2 mm long, feathery. Pedicelled spikelets 4.5 - 5 mm long, sparsely villous; lower glume, upper glume, lemma and florets more or less as in sessile spikelets.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : In moist rocky places.

*Distribution* : INDIA : Kerala (Cannanore). Endemic.

- 25. *Ischaemum kingii*** Hook.f., Fl. Brit. India 7: 129. 1829; Bor, Grass. Burma Ceylon India Pakistan 182. 1960; B.V. Shetty & V. Singh, Fl. Rajasthan 3: 1067. 1993; B.D. Sharma & al., Fl Maharashtra State (Monocot.) 519. 1996.

*Type* : India : Maharashtra; Bombay, *King* s.n. (*Iso* : CAL).

Annuals; culms 25 - 30 cm tall, erect, glabrous. Leaves ovate-lanceolate, 3.5 - 6 x 0.5 - 1.2 cm, rounded or subcordate at base, lower ones petioled, upper sessile, hairy beneath, margins scaberrulous, midrib slender; sheaths lax, spathiform; upper ones glabrous; ligules short, membranous. Racemes 2, *c.* 4 cm long; joints stout,

densely ciliate. Sessile spikelets ovate, 6 - 8 mm long; callus rounded, bearded; lower glume oblong-lanceolate, 4 - 5 mm long, dorsally glabrous, sides bulging at about lower 1/3; upper glume scabrid, 2-toothed at apex, armed with tuft of stiff hairs on upper third; lower lemma lanceolate, 1-nerved; lower palea membranous; upper lemma ovate, short, 3-nerved, lobes triangular, awned; awn *c.* 2.5 cm long; upper palea as long as lemma, ovate-lanceolate, 2-nerved. Lower floret male; upper floret bisexual. Pedicelled spikelets smaller than sessile; pedicels nearly half the length of sessile spikelets; lower glume elliptic, acute, many nerved, margins not incurved; upper glume awnless.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : In drier parts of grassy hills.

*Distribution* : INDIA : Maharashtra and Rajasthan. Endemic.

- 26. *Ischaemum koenigii*** (Hook.f.) Stapf ex C.E.C. Fisch., in Gamble, Fl. Pres. Madras 1722. 1934; Bor, Grass. Burma Ceylon India Pakistan 182. 1960. *I. aristatum* L. ssp. *koenigii* Hook.f., Fl. Brit. India 7: 127. 1896. *I. fasciculatum* Rottler, nom. nud.; Hook.f., Fl. Brit. India 7: 127. 1896 pro syn.

*Type* : India : Deccan Peninsula (Precise locality unknown). *Koenig* s.n. (K).

Robust perennial herbs; culms 70 - 90 cm tall, glabrous. Leaves narrow, 30 - 45 x 2.5 - 3 cm, rounded or emarginate at base, nearly sessile. Racemes 2 - 3, 8 - 10 cm long; joints *c.* 3 mm wide. Sessile spikelets 8 - 10 mm long, nearly glabrous; lower glume oblong-lanceolate, *c.* 3.5 mm long, acute, with 3 - 4 nodules on each margin in lower part, often connected by rounded transverse ridges; upper glume boat-shaped, acute; lower lemma oblong-lanceolate; lower palea delicate; upper lemma notched, shortly bifid, narrowly lobed, awned; awn *c.* 5 mm long; upper palea oblong. Lower floret male; upper floret bisexual. Pedicelled spikelets awnless; pedicels 2 - 3 mm long; glumes, lemmas and paleas as in sessile spikelets.

*Flowering & Fruiting* : Aug. - Dec.

*Ecology* : In marshy habitats.

*Distribution* : INDIA : Tamil Nadu. Endemic.

- 27. *Ischaemum kumarakodiense*** Ravi, Mohanan & Kiran Raj in Rheedeia 8(2): 149. 1998, '*kumarakodiensis*'.

*Type* : India : Kerala; Alappuzha Dt., Pallama, Dec. 29, 1996. *Ravi* 33084 (*Holo* : TBGT; *Iso* : K, MH, KFRI).

Perennials, densely tufted; culms up to 75 cm long. Leaves linear-oblong-lanceolate, *c.* 1.5 x 0.5 cm, rounded at base, acuminate at apex, keeled on midrib, glabrous; sheaths compressed, *c.* 7 cm long, glabrous; ligules 3 - 4 mm long, truncate. Racemes 2, 4 - 7 cm long; joints clavate, 3 - 4 mm long, ciliate on outer angle. Sessile spikelets elliptic, *c.* 5 mm long, glabrous, 9 - 11-nerved, weakly noduled, irregularly wrinkled without nodular interconnection; upper glume boat-shaped, 4 - 5 mm long, 5-nerved, margins incurved, sharply keeled on back, humped below; lower lemma elliptic-lanceolate, *c.* 4 mm long, 3-nerved; lower palea elliptic-lanceolate, margins incurved, 2-nerved; upper lemma elliptic-lanceolate, cleft to middle, awned, 3-nerved; awn *c.* 1.2 cm long; upper palea linear-lanceolate, 2-nerved, sparsely ciliolate on margins. Lower floret male; upper floret bisexual. Pedicelled spikelets ovoid, 4 - 5 mm long; pedicels *c.* 3 mm long, ciliate; lower glume ovate, 9 - 11-nerved, obtuse, notched, winged on one side; upper glume *c.* 4 mm long, coriaceous; lower lemma and palea as in sessile spikelets; upper lemma elliptic-lanceolate, *c.* 3 mm long; palea linear, 2-nerved.

*Flowering & Fruiting* : Sept. - March.

*Ecology* : Forms thick tufts in marshy places.

*Distribution* : INDIA : Kerala. Endemic.

- 28. *Ischaemum lacei*** Stapf ex Bor in Kew Bull. 1950: 187. 1950 & Bor, Grass. Burma Ceylon India Pakistan 182. 1960; U. Shukla, Grass. N.E. India 105. 1996; Sur in J. Econ. Taxon. Bot. 25(2): 421. 2001.

*Type* : Amherst, Daiona, Muleyit Peak, 2000 m, 27.1. 1912, *F.A. Lace* 5627 (K).

Perennials; culms *c.* 120 cm tall, erect, ascending, branched; nodes hairy. Leaves elliptic, 15 - 17 x 1 - 1.5 cm, attenuate at base, densely hairy above, scabrid at margins, median prominent; sheaths lax, compressed, striate, pilose; ligules oblong, *c.* 5 mm long. Racemes 2, 5 - 6 cm long; joints 4 - 5 mm long, ciliate. Sessile spikelets 7 - 9 mm long; callus *c.* 1 mm long, hairy; lower glume lanceolate or ovate, *c.* 8 mm long, narrowly winged, bilobed towards apex, rounded at base, notched at apex, margins involute towards apex, pilose in middle; upper glume lanceolate, *c.* 9 mm long, dorsally keeled, 3-nerved, winged on both sides; arista *c.* 2.5 mm long, scabrous; lower lemma elliptic, *c.* 6 mm long, acute, 3-nerved, hyaline; lower palea as long as lemma, 2-nerved; upper lemma *c.* 6.5 mm long, 3-nerved, notched with narrow fissure, awned; awn *c.* 2 cm long, column *c.* 1 cm long, twisted, brown. Lower floret male; upper floret bisexual. Pedicelled spikelets 8 - 10 mm long; lower glume *c.* 8 mm long, strongly compressed, keeled, dorsally winged, pilose, arista short; upper glume 7 - 8 mm long, rounded at base, keel winged towards apex, scabrid, hairy in middle; florets similar to sessile spikelets, arista *c.* 1 cm long.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : In paddy fields.

*Distribution* : INDIA : Meghalaya; MYANMAR.

*Note* : Bor (*l.c.*) states that *I. lacei* seems to be endemic to Burma (Myanmar).

**29. *Ischaemum lanatum*** Ravi, Mohanan & Shaju in Rheede, 10(2): 91. 2000.

*Type*: India : Kerala; Kasaragode Dt., Hosdurg Taluk, Periya,  $\pm$  50 m, 29 Nov. 1999. *Ravi* 41535 (*Holo* : TBGT; *Iso* : K, CAL, MH, KFRI, TBGT).

Annuals; culms slender, up to 1 m tall; nodes villous. Leaves up to 10 x 1 cm, cordate or semisagittate at base; sheaths up to 9 cm long, keeled on back; ligules triangular, *c.* 5 mm long, coriaceous. Racemes 2, up to 7 cm long, densely woolly; joints 4 - 6 mm long, white woolly. Sessile spikelets elliptic to oblong-lanceolate, 6 - 7 mm long; lower glumes 5 - 6 mm long, elliptic-lanceolate, laterally keeled, 2- 3-nodulose, 9 - 11-nerved, woolly; upper glume oblong-lanceolate, 5 - 6.5 mm long, 5 -7-nerved, incurved at margins; lower lemma elliptic-lanceolate, 4 -5.5 mm long, acuminate, margins inrolled; lower palea 4 - 5.5 mm long, 2-nerved, keeled along nerves; upper lemma oblong-elliptic, 3.75 - 5 mm long, deeply cleft, awned; awn 1.3 - 1.9 cm long with 5 - 8 mm long column; upper palea linear-lanceolate, 3.5 - 4.5 mm long, 2-nerved. Pedicelled spikelets : Pedicels 1.5 - 2.5 mm long, silky villous; lower glume oblong-lanceolate, 4.5 - 6.5 mm long, crustaceous to coriaceous, 7 -11-nerved, silky woolly; upper glume, lower lemma, lower palea, upper lemma and upper palea slightly shorter otherwise as in sessile spikelets. Lodicules 2, *c.* 1 mm long. Stamens 3; anthers *c.* 3 mm long, yellow. Ovary *c.* 1 mm long; style 2 - 2.5 mm long; stigma 3 - 3.5 mm long, purple.

*Flowering & Fruiting* : Oct. - Jan.

*Ecology* : On black loamy soil of a rocky grassy hill in shady places.

*Distribution* : INDIA : Kerala (Kasaragod). Endemic.

*Note* : *I. lanatum* is somewhat allied to *I. semisagittatum* Roxb., but differs in having densely white woolly joints of rachis, pedicel, callus and crustaceous lower glumes.

**30. *Ischaemum lisboae*** Hook.f., Fl. Brit. India 7: 133. 1896; Bor, Grass. Burma Ceylon India Pakistan 182. 1960.

*Type* : India : North Kanara, *Lisboa* s.n. (CAL).

Perennials; culms 20 - 35 cm long, creeping below, stout, rooting at nodes, glabrous. Leaves oblong, 3 - 5 x 0.6 - 1 cm, acute, tomentose or brown villous on both surfaces; sheaths 1.2 - 2.5 cm long, villous; ligules short, hairy. Racemes 2, *c.* 5 cm long, tomentose; joints *c.* 2 mm long; villous, stout. Sessile spikelets 3 - 3.5 mm long; callus large, glabrous; lower glume dorsally convex, *c.* 3 mm long, thick, coriaceous, bifid, ciliate towards apex, margins incurved; upper glume *c.* 3.5 mm long, dorsally rounded below wing, keel winged above middle, shortly awned; lower lemma ovate-oblong, obtuse, ciliate along margins; lower palea obovate, chartaceous, 2-nerved; awn *c.* 6 - 7 mm long; upper palea lanceolate, nerves ciliate. Lower floret male; upper floret bisexual. Pedicelled spikelets laterally compressed; lower glume convex, broadly winged, villous; upper glume, lemma and palea as in sessile spikelets; upper lemma shortly awned or awnless.



*Flowering & Fruiting* : Aug. - Dec.

*Ecology* : In wet places.

*Distribution* : INDIA : Goa, Karnataka, Maharashtra and Tamil Nadu. Endemic.

- 31. *Ischaemum malabaricum*** Sreek., V.J. Nair & N.C. Nair in Kew Bull. 39: 743. 1984; Sreek. & V.J. Nair, Fl. Kerala - Grass. 144. 1991.

*Type* : India : Kerala; Cannanore, Paramba, on way to Bandudka,  $\pm$  150 m, 16.10.1981, P.V. Sreekumar 71720 (*Holo* : CAL).

Annuals; culms creeping; upper nodes villous. Leaves ovate-lanceolate, 1 - 10 x 0.5 - 1.5 cm, cordate at base, long acuminate, usually sessile, at times lower ones with a short petiole; sheaths 1 - 6 cm long, glabrous; ligules 2 - 3 mm long. Racemes 2, 2 - 6 cm long, slender, villous towards base; joints linear-clavate, c. 3 mm long, margins villous. Sessile spikelets ovate-oblong, 3 - 5 mm long, callus bearded; lower glume 3 - 4 x 1 - 1.5 mm, smooth, 9 - 11-nerved, hairy on dorsal surface; upper glume boat-shaped, 3 - 3.5 x c. 1.5 mm, 3 - 5-nerved, margins shortly ciliate; lower lemma elliptic, 3 - 4 x c. 1 mm, acute, 3 - 5-nerved, hairy along margins; lower palea linear-oblong, 3 - 3.5 x c. 1 mm, margins inturned; upper lemma 2.5 - 3 x c. 1 mm, notched, awned; awn 1.2 - 1.5 cm long, column c. 5 mm long; upper palea oblong, obtuse. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 1.5 mm, filaments short. Pistil c. 3 mm long; ovary elliptic; style c. 1.5 mm long; stigma c. 1 mm long, feathery. Pedicelled spikelets elliptic, 3 - 4 mm long, awnless; callus villous; pedicels linear, c. 2 mm long, villous along margins; lower glume elliptic, 3.5 - 4 x c. 1 mm, acute, 9 - 11-nerved, nearly glabrous towards base; upper glume elliptic, 3 - 4 x c. 1.25 mm, acute, margins short ciliate; lower lemma elliptic-lanceolate, 3 - 3.5 x c. 1 mm, glabrous except along margins; lower palea lanceolate, glabrous; upper lemma elliptic, 2 - 3 x c. 1 mm, margins inturned; upper palea linear-oblong, glabrous. Lower and upper florets male. Stamens 1 - 2 mm long, filaments short.

*Flowering & Fruiting* : Oct. - Jan.

*Ecology* : In dry areas, usually trailing over old compound walls.

*Distribution* : INDIA : Kerala. Endemic. Common.

- 32. *Ischaemum mangaluricum*** (Hack.) Stapf ex C.E.C. Fisch. in Gamble, Fl. Pres. Madras 1723. 1934; Bor, Grass. Burma Ceylon India Pakistan 182. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 147. 1991. *I. aristatum* sensu Hack. subsp. *imberbe* Hack. var. *mangaluricum* Hack. in DC., Monogr. Phan. 6: 204. 1889; Hook.f., Fl. Brit. India 7: 127. 1896; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 519. 1996. *I. aristatum* subsp. *imberbe* var. *fallax* Hack. in DC., Monogr. Phan. 6: 204. 1889.

*Type* : India : Tamil Nadu (Madras); Manglur, *Hohenacker* 184 (K).

Perennials; culms up to 80 cm tall, densely tufted, rarely rooting at lower nodes. Leaves linear-lanceolate, 3 - 20 x 0.45 - 0.7 cm, narrowed at base; ligules ovate, acute. Racemes 2, 3 - 10 cm long; joints clavate, 4 - 5 mm long, ciliate on one angle. Sessile spikelets oblong, 4 - 6 mm long, awned; callus bearded; lower glume oblong, 4 - 6 x c. 1.5 mm, crustaceous below, usually with 4 - 6 side nodules never interconnected, tip of lower glume auriculately winged on one side; upper glume boat-shaped, 4 - 6 x c. 1 - 2 mm, chartaceous, dorsally keeled, keel narrowly winged at apex; lower lemma 4 - 5 x 1 - 2 mm, 3 - 5-nerved; lower palea oblong-lanceolate or elliptic-lanceolate, 3 - 5 x c. 1 mm, delicate; upper lemma 4 - 4.5 x 1.5 - 2 mm, notched, awned; awn 1 - 1.5 cm long, column 5 - 6 mm long; upper palea oblong, 3 - 4 x c. 1 mm, sprinkled with wart like dots in upper half; Lower floret male; upper floret bisexual. Stamens 3; anthers c. 2 mm long. Ovary ovate-oblong, c. 0.5 mm long; style 1 - 1.5 mm long; stigma c. 1 mm long. Pedicelled spikelets ovate-oblong, 4 - 5 mm long; pedicels 1 - 1.5 mm long, densely ciliate; lower glume ovate-oblong, broadly winged on one margin; upper glume, lemma and palea similar to sessile spikelets but smaller; florets male; upper lemma awnless.

*Flowering & Fruiting* : Oct. - Feb.

*Ecology* : Common along marshy places and bunds of paddy fields.

*Distribution* : INDIA : Karnataka, Kerala, Maharashtra and Tamil Nadu; SRI LANKA.

*Note* : *I. mangaluricum* is nearer to *I. barbatum* but differs in having smaller culms and auriculate wings on lower glumes.

**33. *Ischaemum molle*** Hook.f., Fl. Brit. India 7: 128. 1896; Bor, Grass. Burma Ceylon India Pakistan 183. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 148. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 523. 1996.

*Type* : India : Madhya Pradesh; Chanda, 28.11.1889, *J.F. Duthie* 9962 (*Syn* : CAL).

Perennials; culms 60 - 150 cm tall, erect, densely tufted; nodes bearded. Leaves linear-lanceolate, 10 - 25 x 0.5 - 1 cm, acuminate, sparsely hairy, cordate at base; sheaths 10 - 15 cm long, nearly glabrous, mouth villous; ligules ovate, truncate, fimbriate, membranous. Racemes 2, 4 - 10 cm long, densely villous; joints turbinate or triangular, 3 - 4 mm long. Sessile spikelets ovate, 5 - 6 mm long, acute, densely villous, awned; callus broad; lower glume oblong-lanceolate, 5 - 6 x c. 1.5 mm, coriaceous, 9 - 11-nerved, densely curved with white hairs, ridges obscure; upper glume boat-shaped, 5 - 7 x 2 - 3 mm, chartaceous, faintly 3 - 7-nerved, dorsally keeled, humped in middle, ciliate; lower glume oblong-lanceolate, 4.5 - 5.5 x c. 1.5 mm, 3 - 5-nerved, margins infolded, ciliolate towards apex; lower palea elliptic-lanceolate, chartaceous, 2-nerved; upper lemma c. 4.5 x 1.5 mm, notched, awned, 3-nerved; awn c. 2 cm long; column 6 - 8 mm long; upper palea oblong-lanceolate, delicate, hyaline, 2-nerved, margins infolded. Lodicules obovate. Lower floret male; upper floret bisexual. Stamens 3; anthers c. 2 mm long. Ovary ovate-oblong, c. 0.5 mm long; style c. 1 m long; stigma c. 5 mm long, feathery. Pedicelled spikelets elliptic or oblong-lanceolate, 4 - 6 m long, awnless; pedicels turbinate, 1 - 2 mm long, villous; lower glume winged on one margin; upper glume as in sessile spikelets but smaller, not humped. Florets, lemmas and paleas as in sessile spikelets.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : In dense clumps along wetlands and in ditches.

*Distribution* : INDIA : Peninsular to Central India and Rajasthan. Endemic.

*Note* : *I. molle* is closely allied to *I. rugosum* but differs in having taller robust culms, shortly petiolate upper leaves and smoother faintly rugose and densely villous lower glumes of sessile spikelets.

*Uses* : A fodder grass.

**34. *Ischaemum muticum*** L., Sp. Pl. 1049. 1753; Hook.f., Fl. Brit. India 7: 132. 1896; Bor, Grass. Burma Ceylon India Pakistan 183. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 149. 1991. *I. repens* Roxb., Fl. Ind. 1: 325. 1820. *I. glabratum* J. Presl ex C. Presl, Rel. Haenk. 1: 328. 1830. *Andropogon muticus* Steud., Syn. Pl. Glum. 1: 374. 1854. *A. polymorphus* Steud., l.c. 1: 375. 1854.

Perennials; culms 10 - 80 cm tall, creeping or trailing, stoloniferous, rooting at nodes. Leaves ovate-lanceolate, 1 - 10 x 0.4 - 1 cm, cordate at base, acuminate at apex; sheaths ciliate at margins; ligules truncate, membranous. Racemes 2, up to 3.5 cm long, concealed or hardly exerted from spathe; joints turbinate, nearly glabrous. Sessile spikelets oblong, 5 - 7 mm long, awnless, or awn rudimentary; callus glabrous; lower glume 5 - 6.5 x 1 - 3 mm, coriaceous, 7 - 11-nerved, minutely winged at apex; upper glume boat-shaped, 5 - 7 x 2 - 3 mm, chartaceous, 3 - 7-nerved, dorsally keeled; lower lemma ovate-lanceolate, 5 - 6.5 x 1.5 - 2.5 mm, 3-nerved, margins infolded; lower palea oblong-lanceolate, 2-nerved; upper lemma oblong-lanceolate, 5 - 7 x 1 - 2 mm, 3-nerved; upper palea elliptic to oblong-lanceolate, acute, margins infolded, ciliolate towards apex. Lodicules 2, obovate, retuse. Lower floret male; upper floret bisexual. Stamens 3; anthers 1.5 - 2 mm long. Ovary ovate-oblong, 0.5 - 1 x c. 0.5 mm; style 1 - 1.5 mm long; stigma c. 2 mm long, feathery. Pedicelled spikelets elliptic or oblong-lanceolate, 4 - 6 mm long, awnless or sometimes reduced into a small structure; pedicels turbinate, 2.5 - 5 mm long.

*Flowering & Fruiting* : July - March.

*Ecology* : Common along banks of back-waters, coastal sands and salt marshes.

*Distribution* : INDIA : Coasts of South India, Andaman & Nicobar Islands, Kerala, Lakshadweep, Maharashtra and Tamil Nadu; MALAYSIA, MYANMAR and SRI LANKA.

*Note* : *I. muticum* is distinct from other species of the genus in having thick rootstock, racemes concealed in spathe and awnless or rudimentary spikelets. This grass acts as a soil binder.

- 35. *Ischaemum nairii*** V.J. Nair & Sreek. in J. Econ. Tax. Bot. 5: 1205. 1894; Sreek. & V.J. Nair, Fl. Kerala - Grass. 150. 1991.

*Type* : India : Kerala; Calicut Dt., Kanjeerakkadav, near Kakkayam,  $\pm 900$  m, 26.11.1981, *P.V. Sreekumar* 71843 (*Holo* : CAL).

Perennial tufted herbs; culms 1 - 2 m tall, erect; nodes villous. Leaves linear-lanceolate, 10 - 60 x 1 - 2 cm, acuminate, lower ones narrowed at base, upper rounded or cordate at base, villous; sheaths 10 - 80 cm long, villous on upper half; ligules ovate, 2 - 6 mm long, membranous. Racemes 2, 5 - 12 cm long, nearly glabrous; joints *c.* 3 mm long, villous along margins and dorsal angles. Sessile spikelets elliptic, 5 - 6 mm long, awned; callus densely bearded; lower glume ovate, 4.5 - 5.5 x 1.5 - 2 mm, acute, with several side nodules joined by sharp ridges; upper glume boat-shaped, *c.* 5 x 1.5 mm, dorsally keeled, tip minutely ridged, 7 - 9-nerved, margins ciliate in upper half; lower lemma oblong-lanceolate, *c.* 5 x 1.5 mm, 3-nerved; lower palea elliptic-lanceolate, 2-keeled, margins infolded; upper lemma notched, 3 - 4 x *c.* 1.5 mm, lobes acute, 3-nerved, margins ciliolate; awn 1.4 - 1.6 cm long, column 6 - 7 mm long, brown; upper palea lanceolate, *c.* 3.5 x 1 mm, 2-nerved, wart like dots towards apex. Lodicules 2, obovate, oblique at apex. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 2 mm long, filaments *c.* 0.5 mm long. Ovary oblong; style *c.* 1 mm long; stigma 1 - 1.5 mm long, feathery. Pedicelled spikelets ovate, 5 - 6 mm long, acute, unawned; pedicels linear-clavate, 2 - 2.5 mm long, villous on dorsal angle; lower glume narrowly winged on one margin, wing scabrid, wrinkled with shallow depressions, side nodules indistinct; upper glume ovate-lanceolate, 4 - 4.5 mm long, 5-nerved; lower lemma delicate, margins infolded, minutely ciliate in upper half; palea oblong-lanceolate, 4 - 5 x *c.* 1.25 mm, texture similar as in sessile spikelet; upper lemma ovate-lanceolate, *c.* 4 x 2 mm, 3 - 5-nerved; palea 3 - 3.5 x *c.* 1 mm. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 3 mm long. Pistil similar to sessile spikelets.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : Tall grass, growing in clumps along shallow streams and marshy places.

*Distribution* : INDIA : Kerala (Calicut). Endemic.

- 36. *Ischaemum nilagiricum*** Hack. in Oesterr. Bot. Z. 51: 150. 1901; Bor, Grass. Burma Ceylon India Pakistan 183. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 153. 1991. *I. hirtum* sensu Hook.f., Fl. Brit. India 7: 135. 1896, non Hack. 1889.

*Type* : India : Tamil Nadu (Madras); Conoor, *C.B. Clarke* 10791 (K, CAL).

Perennials; culms up to 120 cm tall, tufted, erect; nodes glabrous. Leaves elliptic-lanceolate or linear-lanceolate, 5 - 20 x 0.5 - 1.7 cm, acuminate; upper ones rounded at base, lower narrowed at base, softly hairy; sheaths ciliate at margins; ligules ovate, acute, membranous. Racemes 3 - 5 (up to 20), paniculate, each 2 - 10 cm long; joints 3 - 5 mm long, apex with teeth-like projections, angles densely ciliate. Sessile spikelets elliptic-lanceolate, 5 - 6 mm long; densely villous; lower glume 4 - 5 x 1 - 2 mm, notched at apex, 11 - 13-nerved, villous; upper glume boat-shaped, 5 - 6 x 1.5 - 2 mm, acuminate, recurved, 5 - 7-nerved; lower lemma elliptic-lanceolate, *c.* 5 x 1 mm, shortly acuminate, 3-nerved, margins ciliolate towards apex; lower palea elliptic-lanceolate, chartaceous, 2-nerved; upper lemma notched, awned, 5 - 7-nerved; awn 6 - 12 mm long, brown; upper palea lanceolate, 2-nerved with wart-like dots towards apex. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 3 mm. Ovary oblong, *c.* 1 mm long; style 1 - 2 mm long; stigma 2 - 3 mm long, brown. Pedicelled spikelets 5 - 6 mm long, awned; pedicels 2 - 3 mm long, ciliate; lower glume ovate-lanceolate, 5 - 6 x 1.5 - 2 mm, villous, chartaceous, 13 - 15-nerved; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Nov. - April.

*Ecology* : Commonly growing along lakes, streams, ponds and canals, sometimes floating above water.

*Distribution* : INDIA : Karnataka, Kerala and Tamil Nadu. Endemic.

- 37. *Ischaemum pappiniseriense*** Ravi, Mohanan & Rajesh in Rheede 8 (2): 155. 1998, '*pappiniseriensis*'.

*Type* : India : Kerala; Kannur Dt., Pappinisseri, Dec. 12, 1996, *Ravi* 33707 (*Holo* : TBGT; *Iso* : K, MH, KFRI).

Annuals; culms up to 60 cm long, decumbent, terete. Leaves oblong-lanceolate, *c.* 8 x 0.5 cm, lower sessile, upper short petioled, rounded at base, acuminate at apex; sheaths up to 7 cm long, glabrous, dorsally keeled; ligules up to 5 mm long, oblong, notched. Racemes 2, up to 5 cm long; joints turbinate, *c.* 3 mm long, ciliate on outer angle. Sessile spikelets oblong-elliptic, *c.* 5 mm long, densely ciliate; lower glume 4 - 5 mm long, margins incurved, broadly winged on upper half, deeply 3 - 5-noduled on sides in lower half, 13 - 15-nerved; upper glume boat-shaped, *c.* 5 mm long, dorsally keeled, margins incurved, 5-nerved; lower lemma elliptic-lanceolate, 4 - 5 mm long, 3-nerved, margins incurved; lower palea *c.* 4 mm long, hyaline, short ciliate at margins towards apex; upper lemma oblong-lanceolate, deeply cleft, lobes acute, awned from sinus; awns up to 2.2 cm long. Lower floret male; upper floret bisexual. Pedicelled spikelets reduced and empty; pedicels linear-lanceolate, *c.* 3 mm long, ciliate; lower glume oblong, *c.* 3 mm long, 9 - 11-nerved, winged along margins; upper glume *c.* 1 mm long, reduced, acute; all other parts compressed.

*Flowering & Fruiting* : Oct. - March.

*Ecology* : In lowland along water courses.

*Distribution* : INDIA : Kerala. Endemic.

- 38. *Ischaemum pilosum*** (Klein ex Willd.) Wight in Madras Lit. Sci. J. 138. 1835; Hook.f., Fl. Brit. India 7: 130. 1896; Bor, Grass. Burma Ceylon India Pakistan 183. 1960; G.P. Roy, Grass. Madhya Pradesh 103. 1984; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 523. 1996. *Andropogon pilosus* Klein ex Willd., Sp. Pl. 4: 920. 1806.

*Type* : India : Tamil Nadu; *Wallich* 8817 (CAL).

Perennial decumbent herbs; culms 60 - 90 cm tall, slender, terete, glabrous. Leaves linear, finely acuminate, glabrous; sheaths glabrous; ligules 2 - 3 mm long, membranous, glabrous. Racemes sub-digitate, 2 - 6, fascicled, 2.5 - 12 cm long, brown, pilose; joints and pedicels slender, compressed, sparsely ciliate. Sessile spikelets narrowly lanceolate, *c.* 6 mm long; callus bearded with hairs; lower glume narrow, chartaceous, dorsally hairy, margins incurved, nerves anastomosing; upper glume ovate-lanceolate, longer than lower glume, laterally compressed, 5-nerved; lower lemma linear-oblong, obtuse, ciliate above; lower palea membranous, glabrous; upper lemma equal to lower lemma, cleft almost to middle into acute ciliolate lobes, awn 6 - 10 mm long; upper palea lanceolate-subulate. Lower floret male; upper floret bisexual. Stamens 3, filaments *c.* 0.6 cm long. Style *c.* 1.5 mm long; stigma *c.* 1.5 mm long, feathery, brown. Pedicelled spikelets *c.* 4.5 mm long; pedicels shorter than sessile spikelets; awn short, sometimes reduced; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Feb.

*Ecology* : In marshy places on black soil.

*Distribution* : INDIA : Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu. Endemic.

*Note* : Known for its fodder value when young and acts as soil binder in semi-desert areas.

- 39. *Ischaemum pushpangadanii*** Ravi, Mohanan & Kiranraj in Rheedeia 10(1): 49 - 53. 2000.

*Type* : India : Kerala; Kozhikode Dt., Koilandy Taluk, Kakkasyam hills, ± 420 m, *Ravi* 41460, 26.10.99 (*Holo* : TBGT; *Iso* : CAL, MH, KFRI, TBGT).

Annuals; culms tufted, erect to diffuse, stilt-rooted at base; upper nodes villous. Leaves all along culms, ovate to ovate-lanceolate, *c.* 15 x 2 cm, cordate-hastate at base, acute at apex; sheaths keeled, up to 5 cm long; ligules 2 - 7 cm long, notched, coriaceous. Racemes 2, up to 5 cm long, glabrous towards base, densely long villous upwards; joints clavate, 3 - 4 mm long, crustaceous. Sessile spikelets linear-lanceolate, lower ones unawned, upper awned, 6 - 7 mm long; callus *c.* 1 mm long; lower glume linear-lanceolate, *c.* 6 mm long, keeled on back, 2-nerved; lower lemma 4 - 5 mm long, hyaline, incurved on margins, 3-nerved; lower palea 4 - 5 mm, hyaline, incurved, 2-nerved; upper lemma oblong, 3.5 - 4 mm long, bifid, 3-veined and awned from sinus; awn 1.3 - 1.5 cm with column 6 - 7 mm long; upper palea linear-lanceolate, *c.* 3.5 mm long, margins incurved. Pedicelled spikelets linear-elliptic, 3 - 3.5 mm long, smaller; pedicels up to 5 mm long; lower glume 4.5 - 5.5 mm long, coriaceous, 2 - 3-nodulose in basal spikelets; upper glume, lower lemma, lower palea and upper palea as in sessile

spikelets but smaller; upper lemma elliptic-lanceolate, 3-nerved. Lodicules 2, *c.* 0.75 mm long. Stamens 3; anthers 1.75 - 2.5 mm long. Ovary *c.* 0.6 mm long; style *c.* 1.5 mm long; stigma *c.* 2.5 mm long.

*Flowering & Fruiting* : Sept. - Dec.

*Distribution* : INDIA : Kerala. Endemic.

*Note* : Allied to *I. dalzellii* Bor ex Stapf but differs in having more robust habit, sessile spikelets with short *c.* 1 mm long callus, lower glume of sessile spikelets 2 - 4-nodulose, pedicel longer and awn shorter.

**40. *Ischaemum quilonense*** Ravi & Shaju in Rheede 8(2): 152. 1998, '*quilonensis*'.

*Type* : India : Kerala; Kollam Dt., Perumkulam Ela near Kollam Town, Oct. 27. 1996, Ravi 24098 (*Holo* : TBGT; *Iso* : K, MH, KFRI).

Perennials; culms up to 80 cm tall, tufted, creeping; nodes glabrous. Leaves linear-lanceolate, up to 20 x 1 cm, membranous, rounded at base, cuneate at apex; petioles *c.* 2.5 cm long, glabrous; sheaths up to 12 cm long, glabrous; ligules triangular-ovate, up to 5 mm long, glabrous. Racemes 2, rarely 3, up to 10 cm long; joints clavate, nearly glabrous or sparsely ciliate. Sessile spikelets ovate-oblong, 5 - 7 mm long; callus nearly glabrous; lower glume oblong, 5 - 7 mm long, margins incurved, with 3 - 5 nodules, narrowly winged on one side, 11 - 13-nerved; upper glume boat-shaped, 5 - 6 mm long, dorsally keeled, 3 - 5-nerved; lower lemma elliptic, *c.* 5 mm long, margins incurved, 3 - 5-nerved; lower palea shortly notched at apex; upper lemma elliptic, 4 - 5 mm long, cleft at apex, awned; awn up to 1 cm long; upper palea lanceolate, *c.* 4 mm long, notched, 2-nerved. Lower floret male, upper floret bisexual. Pedicelled spikelets oblong-elliptic, pedicels triquetrous, *c.* 2 mm long, nearly glabrous; lower glume oblong-elliptic, thickly keeled on sides, margins incurved; upper glume, lower lemma and palea as in sessile spikelets; upper lemma oblong-elliptic, 4 - 5 mm long, aristate or shortly awned; awn up to 4 mm long. Lower floret male; upper floret bisexual.

*Flowering & Fruiting* : Aug. - March.

*Ecology* : Common in marshy places, roadside pools and bunds of paddy fields.

*Distribution* : INDIA : Kerala. Endemic.

**41. *Ischaemum raizadae*** Hemadri & Billore in Indian For. 96: 318. 1970; Bor in Indian For. 97: 73. 1971; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 523. 1996. *I. borii* S.M. Almeida in J. Bombay Nat. Hist. Soc. 66: 513. 1969.

*Type* : India : Maharashtra; Thane Dt., Sadryaghat near Harischandragarh, 16.11.1968, K.V. Billore 115450A (*Holo*: CAL).

Annuals; culms 15 - 40 cm tall, erect, tufted, glabrous; nodes hairy or glabrous. Leaves linear-lanceolate, 4 - 10 x 0.5 - 1 cm, rounded at base, acute to acuminate at apex, sparsely hairy on both surfaces; sheaths 4 - 6 mm long, striate, margins glabrous; ligules 1 - 2 mm long, scarious. Racemes 2, on long peduncle up to 10 cm, hidden in sheath, 2 - 4 cm long; joints slender, *c.* 2 mm long, hairy along margins. Sessile spikelets lanceolate; callus *c.* 1 mm long, bearded with white hairs; lower glume lanceolate, 4 - 5 x 1 - 1.5 mm, ending in 2 long arista, with small hump on lower half, dorsally glabrous, 4 - nerved, margins incurved with two tufts of hairs; arista 1.3 - 2 cm long; upper glume boat-shaped, 4 - 5 x 1 - 1.25 mm, with hump and tufted hairs in center, keeled above hump, apex bifid, aristate; arista *c.* 4.5 cm long; lower lemma oblong-lanceolate, 3 - 3.5 x 0.6 - 0.8 mm, 1-nerved; lower palea hyaline, 2-nerved; upper lemma boat-shaped, 3 - 3.5 x *c.* 0.5 mm, apex bifid with long awn; awn 3.5 - 5 cm long, scabrid. Pedicelled spikelets lanceolate; pedicels similar to rachis-joint; lower glume 4 - 5 x *c.* 1 mm, coriaceous, compressed, margins keeled in upper half, apex bifid, ending in 4 mm long arista; upper glume oblong-lanceolate, 3-nerved, dorsally covered with white hairs; lower lemma oblong, 3 - 3.5 mm long, 3-nerved, margins ciliate; palea hyaline; upper lemma similar to lower lemma, 3-nerved, apex bifid; palea absent. Stamens *c.* 1 mm long.

*Flowering & Fruiting* : Sept. - Nov.

*Ecology* : On rocks and rock crevices.

*Distribution* : INDIA : Maharashtra. Endemic.

**42. *Ischaemum rangacharianum*** C.E.C. Fisch. in Kew Bull. 1933: 352. 1933 & in Gamble, Fl. Pres. Madras 1722. 1934; Bor, Grass. Burma Ceylon India Pakistan 184. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 155. 1991.

*Type* : India : Malabar, Shoranum, 23.11.1900, *K. Rangachari* s.n. (*Iso* : K, CAL).

Creeping or erect annuals; culms 20 - 80 cm long, rooting at nodes; nodes glabrous. Leaves elliptic-lanceolate, 1 - 13 x 0.5 - 1.3 cm, upper ones cordate at base, acuminate, sessile, lower narrowed and petioled at base, covered with tubercle-based hairs; ligules ovate, *c.* 2.5 mm long, acute, membranous. Racemes 2, adpressed together, appears as solitary, 2 - 6 cm long; joints turbinate, densely ciliate in two rows at one angle. Sessile spikelets lanceolate, 5 - 6 mm long, awned; lower glume oblong-lanceolate, 5 - 6 x 1 - 1.5 mm, coriaceous below with 4 - 5 distinct side nodules, chartaceous, 9 - 11-nerved above, keeled, glabrous or sparsely ciliate in upper half; upper glume elliptic-lanceolate, acuminate, 3-nerved, dorsally keeled; lower lemma oblong-lanceolate, 4 - 5 mm long, delicate, hyaline; lower palea elliptic-lanceolate, 2-nerved; upper lemma notched, 3 - 4 mm long, hyaline, awned, 3-nerved; awn 1.2 - 1.8 cm long; column 6 - 8 mm long; upper palea linear or oblong-lanceolate, 3 - 4 mm long, 2-keeled, 2-nerved. Lower floret male; upper floret bisexual. Stamens 3; anthers 1.5 - 2 mm long. Ovary elliptic-oblong, *c.* 0.5 x 0.2 mm.; style 1.5 - 2 mm long; stigma 1.5 - 2 mm long, purple-red. Pedicelled spikelets lanceolate, *c.* 4.5 mm long; pedicels ciliate, less than 1/3 the length of sessile spikelets, awnless; lower glumes oblong or obovate, 4 - 5 mm long, broadly winged on one margin, faintly 11 - 13-nerved, villous towards base, sometimes with few shallow side nodules on one margin, wing auriculate; upper glume and florets as in sessile spikelets; upper lemma entire and awnless.

*Flowering & Fruiting* : Sept. - March.

*Ecology* : Along hill slopes and roadsides.

*Distribution* : INDIA : Kerala and Tamil Nadu. Endemic.

*Note* : *I. rangacharianum* is distinct from other *Ischaemum* species in having broadly purple-red winged lower glume of pedicelled spikelets and narrowly lanceolate lower glume of sessile spikelets with several distinct side nodules.

**43. *Ischaemum raui*** Sreek., V.J. Nair & N.C. Nair, Fl. Kerala - Grass. 157. 1991.

*Type* : India : Kerala; Cannanore Dt., Muguroad,  $\pm$  150 m, 17 Oct. 1981, *P.V.Sreekumar* 71747 (*Holo* : CAL; *Iso* : K, MH).

Creeping annuals; culms 10 - 35 cm tall, erect or geniculate; nodes villous. Leaves triangular to ovate-lanceolate, 1 - 3 x 0.5 - 1 cm, cordate at base, acute at apex; ligules ovate, *c.* 1 mm long, membranous. Racemes 1 - 2, 2 - 3 cm long, densely villous; peduncle long exserted; joints linear-clavate, 2 - 3 mm long, villous. Sessile spikelets ovate, 3 - 4 mm long, awned, silky villous; lower glume ovate, 3.5 - 4 x 1.5 - 2 mm, acute, 9 - 11-nerved, villous, margins infolded; upper glume ovate-lanceolate, keel rounded except towards apex, minutely winged, ciliate in upper half; lower lemma ovate-lanceolate, hyaline, 3 - 5-nerved, margins infolded, ciliate in upper half; lower palea lanceolate, delicate, faintly 3 - 5-nerved, margins infolded, ciliate in upper half; upper lemma notched, 3 - 3.5 x 1 - 1.25 mm, lobes acute, 3-nerved, ciliolate in upper half; awn 1 - 1.2 cm long, geniculate; column 6 - 7 mm long, brown, bristles pale, scabrid; upper palea oblong-lanceolate, 3 - 3.5 x 0.5 - 0.75 mm, delicate, hyaline, glabrous with warts towards apex. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 1.5 mm long, filaments short. Ovary ovate; style *c.* 1.5 mm long, slender; stigma *c.* 1.5 mm long, feathery. Pedicelled spikelets lanceolate, 3.5 - 4 mm long, unawned, densely villous; pedicels 0.5 - 1 mm long, villous; glumes and floret as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : In marshy places along roadsides.

*Distribution* : INDIA : Kerala (Cannanore). Endemic. Rare

**44. *Ischaemum ritchiei*** Stapf ex Bor in Kew Bull. 1951: 449. 1952 & Grass. Burma Ceylon India Pakistan 184. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 524. 1996.

*Type* : India : Bombay, Kanara, *Ritchie* s.n. (K).

Annual herbs; culms geniculately ascending, 60 - 80 cm tall, rooting at basal nodes. Leaves linear-lanceolate, acuminate; lower leaves *c.* 21 x 1.5 cm; upper ones *c.* 11 x 1.5 cm, glabrous; ligules *c.* 8 mm long, membranous. Racemes 2; joints distinctly turbinate. Sessile spikelets linear-oblong, 5 - 6 mm long, awned; callus bearded; lower glume *c.* 8 mm long, coriaceous up to  $\frac{3}{4}$  the length, noduled at margins, dorsally ridged; upper glume oblong, *c.* 6.5 mm long, 3-nerved, apex bilobed, awned in sinus; upper palea linear-lanceolate, 2-nerved. Lower floret empty; upper floret bisexual. Style branched into 2, stigma plumose. Pedicelled spikelets linear-oblong; lower glume elliptic, *c.* 6 mm long, rugose dorsally, noduled at margins, nodules joined across dorsal surface; lower lemma hyaline, oblong-lanceolate, acute, 3-nerved; palea 2-nerved; upper lemma *c.* 4.5 mm long, 3-nerved. Lower floret male; upper floret bisexual.

*Flowering & Fruiting* : Aug. - Dec.

*Ecology* : Growing in marshy places.

*Distribution* : INDIA : Karnataka and Maharashtra. Endemic.

*Note* : *I. ritchiei* is a very remarkable species with very narrow sessile and pedicelled spikelets in comparison to their length and enmeshed teeth of nodules of adjacent margins.

**45. *Ischaemum rugosum*** Salisb., Ic. Strip. Rar. 1, t. 1. 1791; Hook.f., Fl. Brit. India 7: 127. 1896; Bor, Grass. Burma Ceylon India Pakistan 184. 1960; G.P. Roy, Grass. Madhya Pradesh 104. 1984; Sreek. & V.J. Nair, Fl. Kerala - Grass. 159. 1991; U. Shukla, Grass. N.E. India 105. 1996; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 524. 1996.

*Type* : Nepal, 1821, *Wallich* 8864F (CAL); Sylhet, *Wallich* 8864H (CAL).

*Vern. Names* : Lag, Bardi, Bar Bher, Karkel, Tikigrass, Badawar, Marare (Beng.); Maradi (Santal).

Annual or perennial stoloniferous herbs; culms up to 1 m tall; upper nodes villous, lower ones glabrous. Leaves linear-lanceolate, 3 - 14 x 0.5 - 1.2 cm, tapering towards base, acuminate at apex; ligule ovate, membranous. Racemes 2, 3 - 9 cm long; joints turbinate, densely ciliate at one angle. Sessile spikelets oblong-lanceolate, 4 - 6 mm long; callus sparsely bearded; lower glume oblong-lanceolate, crustaceous below; with prominent side nodules connected by deep ridges, 13 - 15-nerved, scabrid towards apex; upper glume boat-shaped, membranous, keeled, humped on dorsal side; lower lemma oblong-lanceolate, delicate, 3-nerved; lower palea oblong or elliptic-lanceolate, 2-nerved, margins infolded, hyaline; upper lemma notched, deeply bifid up to half the length, awned in sinus; awn 8 - 12 mm long; upper palea shorter than lemma, 2-nerved with few wart-like growths towards apex. Lower floret bisexual; upper floret male. Stamens 3, *c.* 1.5 mm long; style *c.* 1.5 mm long; stigma *c.* 2 mm long. Pedicelled spikelets rudimentary or developed, up to 4.5 mm long, awnless; pedicels less than  $\frac{1}{3}$  the length of sessile spikelets, lower glume *c.* 4.5 mm long, 11 - 15-nerved, winged on one margin; upper glume similar to sessile spikelets. Lower floret absent or sterile; upper floret hermaphrodite or sterile; awned or unawned.

*Flowering & Fruiting* : Dec. - March.

*Ecology* : Frequent along margins of ponds, paddy fields and ditches.

*Distribution* : INDIA : Throughout including Andaman & Nicobar Islands; CHINA, MALAYA, MYANMAR, SRI LANKA and THAILAND.

*Note* : This species can be easily identified by its sharp ridged lower glumes, presence of side nodules across the back and rudimentary pedicelled spikelets.

*Uses* : Young plants are eaten by cattle and horse. Grains are eaten in poorer parts of Madhya Pradesh, as food. Nomadic tribes use it to construct their huts.

**46. *Ischaemum santapau*** Bor in J. Bombay Nat. Hist. Soc. 49: 167. 1950 & Grass. Burma Ceylon India Pakistan 185. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 524. 1996.

*Type* : India : Bombay, Karjat, G.I.P., Rly. River side, 11.12.1949, *H. Santapau* 9665 (K).

Annual caespitose herbs; culms up to 2 m tall, decumbent at base, with many stilt roots, nodes smooth, glabrous. Leaves linear, 15 - 25 x *c.* 1 cm, rounded or shallowly cordate at base, acute at apex, nearly glabrous or coarsely scabrid on both surfaces; ligules 2 - 3 mm long, lacerate, membranous. Racemes binate at apex, 5

- 6 cm long; joints *c.* 3 mm long, 3-angled, long hairy on one angle with oblique articulation. Sessile spikelets oblong; lower glume oblong, *c.* 4.5 x 2 mm, acute, 10 -11-nerved, margins incurved from base to apex; upper glume *c.* 4.5 mm long, boat-shaped, keeled on upper half, membranous, scabrid on dorsal surface; lower lemma hyaline; lanceolate, *c.* 4x 1.5 mm, acute; palea triangular, *c.* 3 mm long; upper lemma *c.* 3.5 mm long, with a geniculate awn in cleft; awn *c.* 1.5 cm long; column brown, twisted, *c.* 6mm long, bristle scabrid. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 2.5 mm long. Style 2, stigma plumose. Lodicules 2, truncate, cuneate. Pedicelled spikelets rudimentary; pedicels *c.* 2 mm long, 2-angled; rudimentary glumes often small but towards base of raceme, *c.* 2 mm long, many nerved.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : In paddy fields, swamps and on sea-shores.

*Distribution* : INDIA : Maharashtra (Mumbai). Endemic.

*Note* : *I. santapau* is peculiar in its habit as it grows in tufts or clumps, with adventitious roots from many nodes.

Santapau states that this plant is very common all over Karjat in rice fields after harvest and along hedges and railway tracts between Khandala and Karjat.

**47. *Ischaemum semisagittatum*** Roxb., Fl. Ind. 1: 322. 1820; Hook.f., Fl. Brit. India 7: 130. 1896; Bor, Grass. Burma Ceylon India Pakistan 185. 1960; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 527. 1996. *Spodiopogon semisagittatum* (Roxb.)Voigt, Hort. Suburb. Calc. 706. 1845. *Meoschium semisagittatum* Schult., Syst. Veg. 2, Mant. 435. 1824. *Andropogon semisagittatum* Steud., Syn. Pl. Glum. 1: 376. 1854. *Ischaemum conjugatum* Roxb., Fl. Ind. 1: 323. 1820; Hook.f., Fl. Brit. India 7: 131. 1896.

*Type* : A native of pasture lands in Bengal.

*Vern. Names* : Dalaga, Ber, Saj-kadi, Kari.

Gregarious tufted herbs; culms up to 60 cm tall. Leaves linear to oblong-lanceolate, 2 - 10 cm long, sagittate at base, acute or acuminate; lower leaves distinctly petioled. Racemes 2 - 5 cm long, softly villous; joints distinctly turbinate. Sessile spikelets linear-oblong, 4 - 6 mm long; callus bearded with long hairs; lower glume with lateral 4 - 5 nodules connected by bar relief ridges, chartaceous, 7 - 9-nerved; upper glume boat-shaped, 3 - 5-nerved, keeled in lower half; lower lemma oblong-lanceolate, delicate, hyaline; upper lemma notched; awn *c.* 4 mm long. Lower floret male or bisexual; Stamens 3; anthers *c.* 3 mm long. Ovary linear-oblong; style 1 - 2 mm long; stigma 2 - 3 mm long. Pedicelled spikelets oblong-lanceolate, *c.* 6 mm long, awned or awnless; pedicels linear-clavate, 1 - 2 mm long, densely ciliate; glumes and florets as in sessile spikelets but smaller.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : On crest of ghats usually in shades of trees.

*Distribution* : INDIA : Andhra Pradesh, West-Bengal, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu; SRI LANKA.

**48. *Ischaemum tadulingamii*** N.C. Nair & Sreek. in Blumea 30: 385. 1985; Sreek. & V.J. Nair, Fl. Kerala - Grass. 160. 1991.

*Type* : India : Kerala; Idukki, Eravikulam National Park, ± 2200 m, 7.4.1980, *P.V. Sreekumar* 71863 (*Holo* : CAL).

Tufted annuals or perennials; culms 10 - 30 cm tall; nodes glabrous. Leaves linear-lanceolate, 2 - 10 x 0.5 - 0.6 cm, narrowed at base, shortly acuminate, sparsely villous. Racemes 2 or 3, 2 - 6 cm long, stout. Sessile spikelets ovate-lanceolate, 6 - 7 mm long; lower glume ovate-lanceolate, acuminate, without nodules, covered with short hairs, margins infolded; lower lemma 4 - 5 mm long, 3-nerved, margins infolded, ciliate in upper half; upper lemma lanceolate, apex notched; awn 1 - 1.2 cm long, geniculate. Lower floret empty; upper floret bisexual. Stamens 3; anthers 1 - 1.5 mm long. Pedicelled spikelets ovate-lanceolate, 4 - 6 mm long, unarmed, usually reduced, striate; pedicels linear-turbinate, 3 - 4 mm long, villous along margins; lower glume



ovate-lanceolate, 4 - 6 mm long, winged on one margin; upper glume ovate-lanceolate, 3 - 5 mm long, glabrous, apex acute, florets empty.

*Flowering & Fruiting* : March - April.

*Ecology* : Along edges of streams and rocky areas in grasslands.

*Distribution* : INDIA : Kerala. Endemic.

**49. *Ischaemum thomsonianum*** Stapf ex C.E.C. Fisch. in Gamble, Fl. Pres. Madras 1722. 1934; Bor, Grass. Burma Ceylon India Pakistan 185. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 163. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 527. 1996. *I. murinum* Hook.f., Fl. Brit. India 7: 135. 1896 non Forst. 1786.

*Type* : India : Tamil Nadu (Madras), 1852, *G. Thomson* s.n. (*Holo* : K; *Iso* : CAL).

Annuals; culms creeping or rooting at nodes, up to 1 m tall, rarely stoloniferous. Leaves lanceolate, 2 - 15 x 0.5 - 1.5 cm, rounded at base, acuminate, densely or sparsely hairy. Racemes 2 rarely 3; joints turbinate, 3 - 4 mm long, densely long ciliate on one angle with a tooth-like projection on inner side. Sessile spikelets elliptic-lanceolate, 5 - 6 mm long, awned; lower glume ovate-lanceolate, 5 - 6 mm long, cuspidate, 11 - 15-nerved; upper glume boat-shaped acuminate, shortly bifid, awned, 5-nerved, dorsally keeled, obscurely winged at apex; lower lemma elliptic, 4 - 5 mm long, acute, margins infolded, ciliolate towards apex; lower palea oblong-lanceolate, 2-nerved; upper lemma notched, awned; awn 1 - 1.5 cm long. Lower floret male; upper floret bisexual. Stamens 3; anthers 2 - 3 mm long. Ovary oblong; style 1 - 1.5 mm long; stigma c. 2 mm long. Pedicelled spikelets oblong-lanceolate, 5 - 6 mm long; lower glume ovate-lanceolate, acuminate, aristate, 11 - 15-nerved, dorsally keeled; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Dec. - March.

*Ecology* : Along paddy fields, roadsides and wastelands.

*Distribution* : INDIA : Karnataka, Maharashtra, Tamil Nadu and Kerala. Endemic. Rare.

*Note* : Shows resemblance to *I. timorense* and *I. zeylanicum* but differs in having longer joints of racemes with tooth-like projections, larger spikelets and glabrous glumes and lower leaves and obscurely winged upper glume of sessile spikelets respectively.

**50. *Ischaemum timorense*** Kunth, Rev. Gram. 1: 369, t. 98. 1830; Hook.f., Fl. Brit. India 7: 136. 1896 p.p.; C.E.C. Fisch. in Gamble, Fl. Pres. Madras 1722. 1934; Bor, Grass. Burma Ceylon India Pakistan 185. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 164. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 527. 1996. *Andropogon blumii* Nees ex Steud., Syn. Pl. Glum. 1: 373. 1854. *Spodiopogon blumii* Nees ex Steud., l.c. 1: 373. 1854. *Andropogon asthenos* Steud., l.c. 1: 376. 1834. *A. timorense* Steud., l.c. 1: 376. 1854.

*Type* : Java, 1827, *Wallich* 8863 (CAL).

Perennials; culms 60 - 120 cm tall, creeping, stoloniferous, rooting at nodes. Leaves linear-lanceolate, 1 - 2 x 0.1 - 0.8 cm, cordate, acuminate. Racemes solitary or in pairs, 1 - 4 cm long, hairy; joints turbinate, 2 - 3 mm long, ciliate along one angle. Sessile spikelets ovate-lanceolate, 3 - 4 mm long, shortly bicuspidate, 7 - 9-nerved; upper glume lanceolate, shortly bifid at apex, aristate in between; lower lemma oblong-lanceolate, c. 3 mm long, 3-nerved; lower palea lanceolate, 2-nerved; upper lemma notched, awned; awn 1 - 1.5 cm long. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 1.5 mm long. Ovary oblong; style c. 1 mm long; stigma c. 1 mm long. Pedicelled spikelets oblong-lanceolate, 3 - 4 mm long; pedicels turbinate, long ciliate on one angle; lower glume ovate-lanceolate, acuminate, shortly aristate, 5 - 7-nerved; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Sept. - Dec.

*Ecology* : Along roadsides, canals and marshy places; usually trailing on sandy soil in damp places.

*Distribution* : INDIA : Andaman & Nicobar Islands, Kerala, Maharashtra, N.E. India and Tamil Nadu; MALAY ISLANDS, MYANMAR and SRI LANKA.

*Note* : This species is distinct for its long, runner-like creeping and stoloniferous culms with rosette like nodal clusters of short lanceolate leaves.

**51. *Ischaemum travancorense*** Stapf ex C.E.C. Fisch. in Kew Bull. 1933: 353. 1933; Bor, Grass. Burma Ceylon India Pakistan 186. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 165. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 530. 1996. *I. aristatum* L. subsp. *rottleri* Hook.f., Fl. Brit. India 7: 127. 1896.

*Type* : India : Travancore, Alleppey, 20.11.1893, *M.A. Lawson* 130 (*Iso* : CAL).

Perennial straggling herbs; up to 2 m tall, rooting at lower nodes. Leaves lanceolate, 5 - 30 x 0.5 - 1.5 cm, cordate, acuminate; petioles short, hairy. Racemes 2, adpressed together, appears solitary; joints clavate-turbinate. Sessile spikelets oblong-lanceolate, awnless; lower glume oblong with few side nodules connected by shallow ridges, 13 - 15-nerved, minutely winged at apex; upper glume boat-shaped, 5 - 7-nerved, dorsally keeled; lower lemma oblong-lanceolate, 3-nerved, margins infolded; lower palea 2-nerved; upper lemma notched with a rudimentary awn in between. Lower floret male; upper floret bisexual. Stamens 3. Ovary oblong; style c. 2 mm long; stigma c. 2 mm long, yellow. Pedicelled spikelets ovate-oblong, awnless; pedicels clavate, turbinate, 2 - 3 mm long, glabrous; lower glume ovate-oblong, winged on one margin; upper glume and florets as in sessile spikelets, but smaller.

*Flowering & Fruiting* : Sept. - March.

*Ecology* : Along streams, muddy fields and canals.

*Distribution* : INDIA : Daman, Diu, Kerala, Maharashtra and Tamil Nadu. Endemic. Occasional.

*Note* : Closely related to *I. vembanadense* but differs in having longer leaves, awnless sessile spikelets and broadly winged lower glume of pedicelled spikelets.

**52. *Ischaemum tumidum*** Stapf ex Bor in Kew Bull. 1951: 450. 1952 & Grass. Burma Ceylon India Pakistan 186. 1960; Sreek. & V.J. Nair, Fl. Kerala - Grass. 167. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 530. 1996.

*Type* : India : Concan, *Stocks* s.n. (K).

Annuals; culms 15 - 30 cm tall, creeping or geniculate; upper nodes bearded. Leaves ovate-lanceolate, up to 4 cm long, hairy on both sides, hairs deciduous, lower leaves usually not petioled, but at times with a short petiole, acute, cordate or shortly sagittate at base; ligules truncate, membranous. Racemes clavate, 2 - 4 cm long, swollen, shining. Sessile spikelets oblong, c. 6 mm long, awned; lower glume c. 6 mm long, coriaceous with 2 - 3 nodules on rounded keels, obscurely transversely ridged, shining below; upper glume elliptic, boat-shaped; lower lemma oblong-lanceolate, delicate, 3-nerved, margins infolded, ciliate on upper half; lower palea delicate, 3-nerved; upper lemma deeply notched, awned, lobes acute, ciliate towards apex. Lower floret male; upper floret bisexual. Stamens 3; anthers 1 - 2 mm long. Pedicelled spikelets lanceolate, 5 - 6 mm long, awnless, hairy; pedicels clavate, hairy; lower glume oblong-lanceolate, 9 - 11-nerved, hairy; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Oct. - Dec.

*Ecology* : Along dry, open and grassy hill slopes.

*Distribution* : INDIA : Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu. Endemic. Rare.

*Note* : *I. tumidum* is distinct from all other Indian species in having characteristic swollen raceme joints and smaller leaves.

**53. *Ischaemum vembanadense*** Patil & D'Cruz in J. Bombay Nat. Hist. Soc. 70: 324. (1973) 1974; Sreek. & V.J. Nair, Fl. Kerala - Grass. 168. 1991.

*Type* : India : Kerala; Alleppey back-waters, 10.1.1970, *Patil* 1919 (K, CAL).

Perennials; culms 30 - 150 cm long. Leaves lanceolate, 5 - 12 x 0.5 - 1 cm, cordate at base, lower ones with a small hairy petiole, acuminate. Racemes 2, 5 - 8 cm long; adpressed together, appears solitary. Sessile

spikelets oblong-lanceolate, 5 - 6 mm long, usually awned, rarely awnless; lower glume crustaceous below with 4 - 6 side nodules with ridges and furrows, 13 - 15-nerved; upper glume boat-shaped, dorsally keeled, chartaceous, 3-nerved; upper lemma deeply notched, awned or rarely awnless; awn 10 - 15 mm long; upper palea 2-nerved. Lower floret male; upper floret bisexual. Stamens 3; anthers *c.* 2 mm long. Ovary oblong; style 1.5 - 2 mm long; stigma *c.* 2 mm long. Pedicelled spikelets oblong, awnless; pedicels 1 - 2 mm long, glabrous; lower glume narrowly winged on one margin; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Oct. - Jan.

*Ecology* : Along banks of rivers and canals; occasionally floating over aquatic weeds.

*Distribution* : INDIA : Kerala (Alleppey). Endemic. Rare.

*Note* : *I. vembanadense* closely resembles *I. travancorensis* but differs in shorter leaves and racemes, awned sessile spikelets and narrowly winged margin of lower glume of pedicelled spikelets.

**54. *Ischaemum wayanadense*** Ravi, Mohanan & Shaju in Bot. Bull. Acad. Sin. 42: 223. 2001.

*Type* : India : Kerala; Kelloor, Thekkumpara ± 800 m, 14. Dec. 1996, *Ravi* 33779 (*Holo* : TBGT; *Iso* : K, CAL, MH, KFRI).

Perennials; culms tufted, up to 1.5 m long. Leaves linear-lanceolate to elliptic, up to 15 x 1.2 cm, cuneate, acuminate; ligules triangular, *c.* 3 mm long. Racemes 2, up to 7 cm long; joints triquetrous, 3 - 4 mm long. Sessile spikelets oblong-clavate, 5 - 6 mm long, with *c.* 1 mm long callus; lower glume oblong-ovate, 4 - 5 mm long, crustaceous, laterally keeled, winged or wingless, nodulose below with obscure interconnecting ridges, 11 - 13-nerved; upper glume 4 - 5 mm long, boat-shaped, keeled, narrowly winged, 5-nerved; lower lemma elliptic-lanceolate, 4 - 5 mm long, 3-nerved; lower palea elliptic-lanceolate, 3.5 - 4.5 mm long, 2-nerved; upper lemma 4 - 4.5 mm long, cleft to middle, hyaline, awned; awn up to 1.5 cm with column *c.* 8 mm long; upper palea elliptic-lanceolate, *c.* 3 mm, 2-nerved, incurved on sides. Pedicelled spikelets : Pedicels 1 - 2 mm long, turbinate; lower glume oblong-elliptic, 4.5 - 5 mm long, laterally keeled, broadly winged; upper glume without apical wing; lower lemma, lower palea and upper palea as in sessile spikelets. Lodicules 2, *c.* 0.2 mm long. Stamens 3; anthers 1 - 2 mm long. Ovary *c.* 2 mm long; style *c.* 2.5 mm long; stigma *c.* 2 mm long, purplish black.

*Flowering & Fruiting* : Sept. - Feb.

*Ecology* : Along bunds of water channels in cultivated fields and roadsides.

*Distribution* : INDIA : Kerala (Kelloor, Thetturvadi). Endemic.

*Note* : Allied to *I. vembanadense* Patil & D'Cruz but differs in having non aquatic habit, reddish-brown herbage, spreading culms rooting at lower nodes, shorter blades, and shorter spikelets.

**55. *Ischaemum yadavii*** Harshala Gad & Janarth. in Kew Bull. 62: 499. 2007.

*Type* : INDIA; Goa, Surla, *Harshala Gad & M.K. Janarthanam* 240 (*holo* : CAL; *ISO* : BSI, K, MH).

Annuals. Culms tufted, erect, up to 45 cm high; nodes villous to glabrous. Leaves all along the culm; sheath up to 5 cm long, keeled on the back; ligule subcoriaceous, *c.* 5 mm long. Inflorescence of two racemes, appressed, up to 3.5 cm long, shortly exserted from spatheolate sheath. Joints of rachis triquetrous, oblong-clavate, *c.* 3.5 mm long, crustaceous. Sessile spikelet : lower glume oblong-ovate, *c.* 5 x 2 mm, thickly crustaceous convex-bulged in the lower  $\frac{3}{4}$  region, 10-11-nerved. Upper glume boat-shaped, *c.* 5 x 2 mm, coriaceous, 3-5 nerved, sharply keeled on back. Lower floret staminate. Lower lemma elliptic-lanceolate, *c.* 4.5 x 1.5 mm, acute at apex, 3-nerved, narrowly winged at apex. Palea elliptic-lanceolate, *c.* 4 x 1.5 mm, 2-nerved. Stamens 3; anthers *c.* 2 mm long, yellow. Upper floret bisexual. Upper lemma oblong-lanceolate, *c.* 4 x 2 mm, hyaline, awned in sinus up to 25 mm long. Palea oblong-lanceolate, *c.* 3 x 1 mm, 2-nerved, margins infolded. Lodicules 2, denticulate, *c.* 1 x 0.5 mm. Stamens 3; anthers *c.* 1.5 mm long. Ovary oblong-lanceolate, *c.* 1 mm long; styles *c.* 2 mm long; stigma plumose, *c.* 1.5 mm long. Pedicelled spikelet obliquely oblong-elliptic, *c.* 4 x 1.5 mm, subacute at apex. Lower glume obliquely oblong-elliptic, *c.* 4 x 1.5 mm, 9-nerved, subacute. Upper glume obliquely ovate *c.* 4 x 2 mm, chartaceous, 3-nerved, 1-keeled, subacute at apex. Lower and upper florets staminate. Lemmas and paleas same as sessile spikelet, upper lemma entire, unawned.

*Flowering & Fruiting* : Oct. – Jan.

*Ecology* : This species grows in open areas of latertic rocky plataeu.

*Distribution* : India : Goa

*Note* : This species is allied to *I. santapau* but differs in crustaceous bulged lower glumes of sessile spikelet, dorsally humped, narrowly winged keel of the upper glume of the sessile spikelet and well developed pedicelled spikelet.

**56. *Ischaemum zeylanicum*** Bor, Grass. Burma Ceylon India Pakistan 186. 1960; V.J. Nair & V.S. Ramach. in Bull. Bot. Surv. India 22: 193. 1980; Sreek. & V.J. Nair, Fl. Kerala - Grass. 169. 1991; B.D. Sharma & al., Fl. Maharashtra State (Monocot.) 532. 1996. *Ischaemum timorense* Kunth var. *zeylanicum* Hack. in DC., Monogr. Phan. 6: 230. 1886. *I. timorense* sensu Hook.f., Fl. Brit. India 7: 136. 1896, p.p.

*Type* : Sri Lanka (Ceylon) *Thwaites C.P.* (CAL).

Annuals or perennials; culms 30 - 100 cm long, willowy, geniculate or trailing. Leaves elliptic-lanceolate, lower leaves petiolate; petioles up to 5 cm long. Racemes 2, slender, hairy; joints with tooth-like projections on inner side, densely long ciliate. Sessile spikelets ovate-lanceolate, 4 - 5 mm long, awned; callus sparsely bearded; lower glume ovate-lanceolate, 4 - 4.5 x c. 2 mm, bicuspidate; upper glume boat-shaped, acuminate, aristate; arista 1 - 2 mm long; lower lemma oblanceolate, 3-nerved, ciliolate towards apex; lower palea 2-keeled, margins infolded; upper lemma 3 - 4 mm long, notched, awned, delicate. Lower floret male; upper floret bisexual. Stamens 3; anthers 2 - 3 mm long. Ovary oblong; style 1 - 1.5 mm long; stigma 1.5 - 2 mm long. Pedicelled spikelets 4 - 5 mm long, awned; pedicels turbinate, densely hairy; lower glume ovate-lanceolate, acuminate, 11- 13-nerved; upper glume and florets as in sessile spikelets.

*Flowering & Fruiting* : Oct. - March.

*Ecology* : Along margins of forests, growing in shades.

*Distribution* : INDIA : Andaman Islands, Assam, Kerala, Maharashtra; BANGLADESH, SRI LANKA.

*Note* : Nearer to *I. timorense* but is quite distinct from it in having petiolate lower leaves, tooth-like projections on inner side of raceme joints and glabrous glumes.

## भारत में वंश ईसकीमम एल. ( पोऐसी )

एस.के. श्रीवास्तव और वी.जे. नायर

### सार संक्षेप

वर्तमान पेपर भारत में वंश ईसकीमम एल. का वर्गीकरण प्रस्तुत करता है। 56 प्रजातियों में, जो भारत में मान्यता प्राप्त हैं, 43 स्थानिक हैं।

## REVISION OF GENUS *DOCYNIA* DECNE. (ROSACEAE) IN INDIA

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### ABSTRACT

The revisionary studies of the genus *Docynia* Decne. in India, recognises three taxa viz. *Docynia hookeriana* Decne., *D. indica* (Colebrooke ex Wall.) Decne., *D. indica* var. *griffithiana* (Decne.) Ghora described from Eastern Himalaya. They are described here with indication of their types and specimens studied.

**Keywords :** *Docynia*, India, Taxonomy.

### INTRODUCTION

The genus *Docynia* Decne. was described by Decaisne (1874) with *Docynia indica* (Wall.) Decne., *D. griffithiana* Decne. and *D. hookeriana* Decne. mainly from Indian subcontinent, viz. Khasia and Eastern Himalaya. Wallich (1831) described Colebrooke's collection from Bangladesh as *Pyrus indica* Wall. and later this was transferred by Decaisne (1874) under *Docynia*. Hooker (1878), Grierson (1987) treated *Docynia* Decne. as a distinct genus and recognised two species in *Docynia* Decne. viz. *D. indica* (Wall.) Decne. (= *D. griffithiana* Decne.) and *D. hookeriana* Decne. from Eastern Himalayan region. Some taxonomists treated *D. griffithiana* Decne. as a synonym of *D. indica* (Wall.) Decne. Later Ghora (2005) treated *D. griffithiana* Decne. as a variety, viz. *D. indica* (Wall.) Decne. var. *griffithiana* (Decne.) Ghora. During the revisionary studies of the genus in India, the specimens of the *Docynia* present in Central National Herbarium (CAL), BSHC, ASSAM and also the cards from Kew Herbarium mentioning the distribution together with Wallich herbarium sheets, microfiche sent from Kew Herbarium (K) and type sheets of the relevant species available were examined. The relevant literatures including protologues were studied. The taxonomic treatment of the genus *Docynia* Decne. in India is presented here.

### DOCYNIA

Decne. in Nouv. Arch. Mus. Paris 10: 131. t. 14. 1874; Hook. f., Fl. Brit. India 2: 369. 1878; C.B. Clarke in J. Linn. Soc. 25: 20. 1887; Gamble, Man. Ind. Timb. 320. 1887; Brandis, Ind. Trees, 289. 1906; C.K. Schneid. Fedde. Repert. Nov. Sp. Reg. Veget. III. S. 179. 1906; Kanjilal & Das, Fl. Assam, 2: 210. 1938; Haridasan & Rao, For. Fl. Meghalaya, 1: 345. 1985; Mabberley, Pl. Book 191. 1986; Grierson, Fl. Bhutan 1(3): 603. 1987.

Small tree, young branches whitish tomentose, stem spiny, modified into branches at maturity. Leaves simple, young leaves lobed or lobulate, mature leaves ovate-lanceolate, margin serrate or serrulate, entire or repand, white woolly or glabrous beneath. Stipules small, linear lanceolate, red, woolly on both surfaces, subulate. Petioles white tomentose. Flowers in axillary umbel. Bracts linear. Hypanthia clavate or globose. Sepals 5. Petals 5. Stamens 40-50. Carpels 5, ovary 5-celled; styles 5, united at base, ovules 3. Fruit pome, pyriform, round or ovoid, pulp hard, 4-5 cm in diam., 5-celled usually with 3 seeds in each, calyx persistent in fruit.

The genus *Docynia* Decne. includes 5 species distributed in Eastern Himalaya, Nepal, Bhutan, W. China (Mabberley, 1987). In India two species with an additional variety are found to grow wild, viz. *D. hookeriana* Decne., *D. indica* (Wall.) Decne., and *D. indica* (Wall.) Decne. var. *griffithiana* (Decne.) Ghora.

*Type:* Meghalaya: "Khasia, regio temp. alt. 5000 pds.", *Hooker & Thomson* 511 (Holotype- K).

## KEY TO THE SPECIES

- 1a. Fruit globose; leaves ovate to lanceolate, margin serrulate to distantly serrate or entire, glabrous above, densely white woolly beneath or veins pubescent only; calyx tube globose; pedicels 10-25 mm long ..... 2. *D. indica*
- 1b. Fruit oblong to elliptic or sometimes pyriform; leaves lanceolate or spiny lobulate, margin crenate to denticulate, glabrous on both surfaces; calyx tube turbinate or pyriform, pedicels 5-10 mm long ..... 1. *D. hookeriana*

**1. *Docynia hookeriana*** Decne. in Nouv. Arch. Mus. Paris 10: 131. t. 15. 1874; Hook. f., Fl. Brit. India 2: 369. 1878; Kanjilal & Das, Fl. Assam 2: 211. 1938; Shastri & *al.*, Wealth Ind. 3: 97. 1952.

*Popular names:* Soh-Phoh-Heh, Dieng-Soh-Pho (Khasi).

Small tree, up to 1.2 m high; branches spreading, glabrous, pubescent when young. Leaves 8.5-13 x 2.5-5 cm, lanceolate, base cuneate to round, apex long acuminate, margin usually denticulate or spiny serrate with lobes, rarely entire, glabrous on both surfaces, tomentose on veins and on midrib only beneath; veins 6-7 pairs; petioles 1.5-3.2 cm long, glabrous. Stipules 5-6 mm long, filiform, glabrous. Flowers usually solitary, or very few in umbel, 2.5-3 cm in diam. Bracteoles 3-5 x 1 mm, lanceolate, glabrous, deciduous. Pedicels 5-8 mm long (10 mm in fruit), glabrous. Hypanthia turbinate or pyriform. Sepals 5, 6-7 x 1-2 mm, obovate, white. Stamens many, filaments 8-9 mm long, filiform, anther lobes 1 x 1 mm, yellowish. Styles 5, 10-11 mm long, united at base, with woolly up to middle half from base, ovary 10 x 7 mm, tomentose, 5-celled. Fruit (Pome) 2-4 x 1.3-2.3 cm, oblong to ellipsoid or fusiform, tomentose to pubescent.

*Flowering* : Feb.-Mar. *Fruiting* : Oct.-Nov.

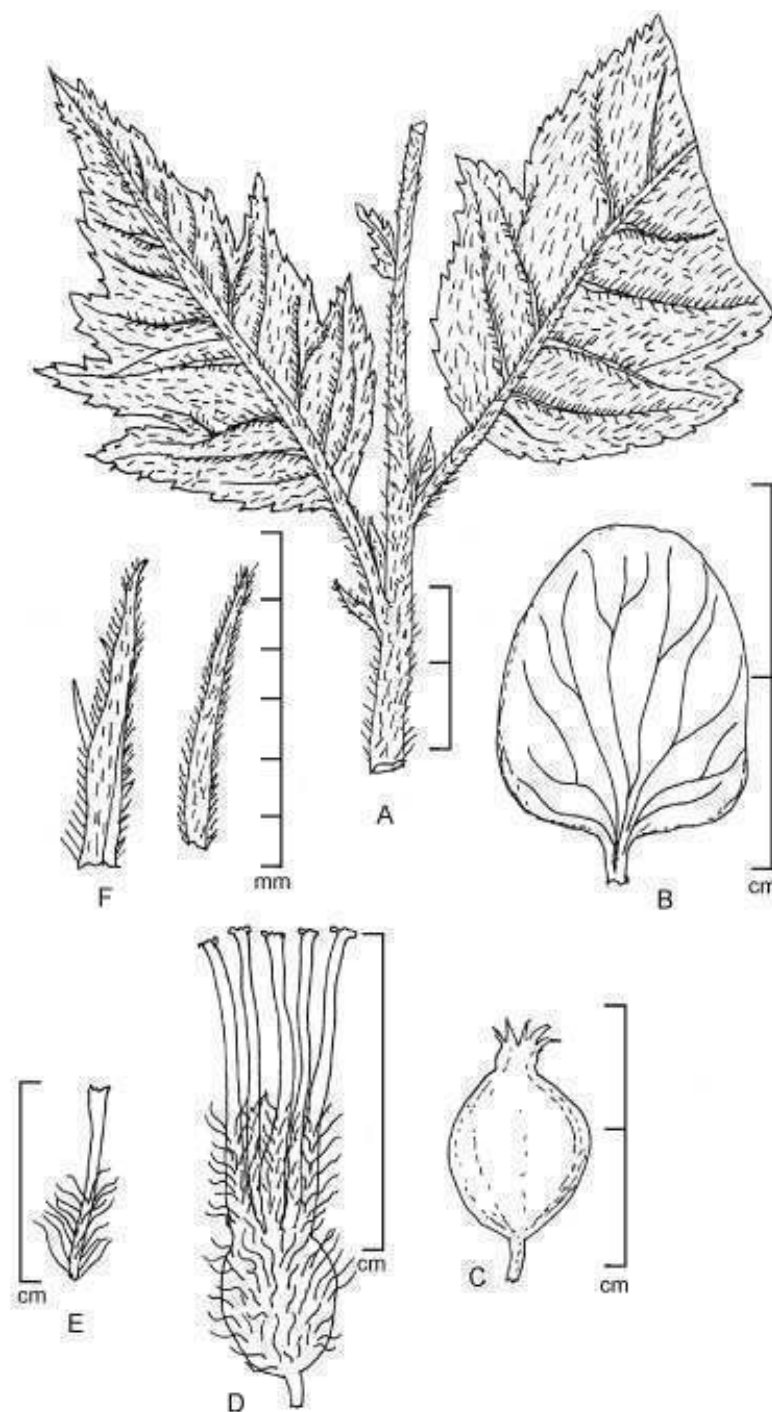
*Distribution:* India: Grows up to 1520 m. altitude (Assam, Meghalaya).

*Uses:* Fruits are edible and wood is used for making drums and tomtom.

*Representative specimens* : Meghalaya: Shillong, Khasi hills, June 1918, *H.G. Carter* 876(CAL); Khasia, 16 June 1885, 1824 m, *C.B. Clarke* 38306A; *Sine prop. loc.*, *s.l. s.n.* (CAL acc. no. 561349).

**2. *Docynia indica*** (Wall.) Decne. in Nouv. Arch. Mus. Paris 10: 131. t. 14. 1874; Hook. f., Fl. Brit. India 2: 369. 1878; C.B. Clarke in J. Linn. Soc. 25: 20. 1887; Gamble, *man. Ind. Timb.* 320. 1902; Brandis, *Ind. Trees* 289. 1906; Kanjilal & Das, Fl. Assam, 2: 211. 1938; Shastri & *al.*, Wealth Ind. 3: 96. 1952; Deb in Bull. Bot. Surv. India 3: 258. 1961; Biswas in Fl. Darj. 321. 1966; Balakrishnan, Fl. Jowai 1: 190. 1981; Haridasan & Rao in For. Fl. Meghalaya 1: 345. 1985; Grierson in Fl. Bhutan 1(3): 603. 1987; Hajra & *al.*, Fl. Arunachal Pradesh 1: 417. 1996; Chauhan & *al.* in Fl. Namdapha, 159. 1996 & in Fl. Manipur 1: 347. 2000. *Pyrus indica* Colebr. ex Wall., Pl. As. Rar. 2: 56. t. 173. 1831; Roxb. [Hort. Beng. 38. 1814] Fl. Ind. 2: 511. 1832; Kurz, For. Fl. Brit. Burma 1: 441. 1877. *Cydonia indica* (Wall.) Spach, Suite Buff. 2: 158. 1834; Wenzig in Linnaea, 12. 1974. *Eriolobus indica* (Wall.) C.K. Schneid., Ill. Handb. Laubholz. 1: 730. 1906; Cowan & Cowan, N. Beng. 61. 1929. *Docynia griffithiana* Decne. Nouv. Arch. Mus. Paris, 10: 131. 1874. *D. indica* (Wall.) Decne. var. *griffithiana* (Decne.) Ghora in Bull. Bot. Surv. India 47(1-4): 149-150. 2005. (Fig. 1)

Tree erect, 3.6 to 7.6 m high, young branches whitish tomentose, stems, lower branches stout, spiny. Young leaves 3-4 lobed to lobulate, mature leaves 9.5-13.5 x 3.0-4.2 cm, ovate to lanceolate, base cuneate to cordate, apex abruptly long acuminate, margin argute serrulate or distantly serrate, glabrous above, young leaves densely white woolly beneath, glabrous at maturity; petioles 2-4 cm long, white tomentose. Stipules 6 x 1 mm, linear lanceolate, reddish, margin woolly or sometimes woolly on both surfaces. Inflorescence axillary, usually 3-flowered, umbel sessile. Bracts 5-6 x 1 mm, linear. Flowers pedicellate. Pedicels 10-25 mm long, tomentose. Hypanthia globose tomentose. Sepals 5, 1.0-1.5 x 0.6-0.7 cm, lanceolate, white villous on both surfaces. Petals 5, 14-20 x 10-11 mm, oblong-obovate, white fragrant. Stamens 45-50, filaments 8-9 mm long, filiform, anther yellowish. Styles 5, 10-11 mm long, long woolly from base up to half of the length, united only at base forming a cone, ovary 10 x 7 mm, woolly. Pomes 1.6-1.8 x 2-5 cm, globose, pubescent, glabrous at maturity, green with orange spots, crowned by the calyx lobes, usually 5-celled, cells 3-seeded. (Fig. 1, Plate-2).



**Fig. 1.** *Docynia indica* (Wall.) Decne. A. Habitat; B. Petal; C. Fruit; D. Pistil; E. Single style; F & G Stipules. [U. Kanjilal 2473 (CAL)].

*Popular names:* Indian crab apple, false quince (Eng.); Soh-Phoh, Dieng-Soh-Poh (Khasi); Likung (Lepcha); Mehul, Passy (Nepal).

#### KEY TO THE VARIETIES

- |  |                                 |
|--|---------------------------------|
| 1a. Leaf margin distantly serrate, glabrous above, densely white woolly beneath when young, glabrous at maturity       | ... a. var. <i>indica</i>       |
| 1b. Leaf margin usually entire, repand, rarely crenate in apical part, glabrous above, tomentose beneath on veins only | ... b. var. <i>griffithiana</i> |

**2a. var. indica**

*Pyrus indica* Colebr. ex Wall., Pl. As. Rar. 2: 56. t. 173. 1831.

*Type*: Bangladesh: 'in montosis Syllet Bengalae Orientalis', *Colebrooke s.n.* (K).

*Cydonia indica* (Wall.) Spach, l.c. *Eriolobus indica* (Wall.) C.K. Schneid. L.c.

*Flowering*: Feb.-Mar. *Fruiting*: Sept.- Dec.

*Distribution*: India: Grows wild at 1200-2000 m. altitude (Sikkim, Meghalaya, Assam, Manipur, Nagaland, Arunachal Pradesh, West Bengal: Darjeeling).

Nepal, Bhutan, Myanmar, China; also cultivated for fruits.

*Note*: The fruit has harsher and austere taste, in a less degree than English Crab Apple and has a little flavour of quince.

*Uses*: The fruit (pome) is acidic, eaten raw or cooked, stewed. Light brown wood is used for tool handles and branches for walking sticks.

*Representative specimens examined*: Sikkim: Sureil, 25 Mar. 1908, *Ribu* 679 (CAL); *Dr. S.K. Mukherjee* 2107 (CAL acc. no. 553696); Yoksam, 1700 m, 16 May 1960, *H. Hara, H. Kanai & al* 6459. West Bengal: Kalimpong, 1520 m, March 1875, *s.l.* 1121D (CAL acc. no. 153558); Kalimpong, 1520 m, *G.S. Gamble ? s.n.*; Kalimpong, 1520 m, March 1875, *Gamble* 671 (CAL acc. no. 153560). Darjeeling, *J.D. Hooker s.n.* Assam: *Kurz s.n.* (CAL acc. no. 153569). Meghalaya: Humid corner of the north of Markasa market, Nongston area, Khasi & Jaintia Hill dist., 18 June 1958, *G. Panigrahi* 16414 (two sheets); Khasi Hills, 1520 m, *Kurz* 417; Khasi hills, Jowai Road, Mar. 1918, *H.G. Carter* 776; Khasi Hills, Nongpum, June 1920, *H.G. Carter* 1941 (two sheets); *sine prop loc.*, *s.l. s.n.* (CAL acc. no. 153581); Khasi Hills, Laitumkhra, 1520 m, 5 Sept. 1913, *U. Kanjilal* 2473; Shillong, *s.l.* 22 (CAL); 1824 m, *s.l. s.n.* (CAL acc. no. 153565); Jowai, May 1879, *s.l. s.n.* (CAL acc. no. 153574); Khasi, May 1874, *s.l. s.n.* (CAL acc. no. 153575); Shillong, 10 Apr. 1959, *H. Deka* 18319 (two sheets). Manipur: Kanpopki, 1033.6 m, 16 Aug. 1953, *D.B. Deb* 954; Bishenpur, 1520 m, Feb. 1906, *A. Meebold* 5617a; Mao, 1824-2128 m, 22Feb. 1882, *G. Watt* 6157. Nagaland: Kohima, 1886, *D. Prain s.n.* (CAL acc. no. 153583); Naga Hill, Aug. 1846, *s.l. s.n.* (CAL acc. no. 153582). Arunachal Pradesh: Kameng F.D. (NEFA), Kolatang North, 12 May 1958, *G. Panigrahi* 15446. (all at CAL)

The following specimens present in Kew Herbarium (K) are recorded from Kew cards of CAL herbarium sent from Kew: Sikkim: *J.D. Hooker s.n.* West Bengal: Darjeeling, *J.D. Hooker s.n.*; above Kalimpong, 1520 m, Mar. 1875, *Gamble* 1121A; Mungga near Kalimpong, 11 Nov. 1875, *Gamble* 229. Assam: S.W. Corner of Ape Tani Valley, 14 Apr. 1965, *Coix & Hutchinson* 335; *Kurz s.n.* Nepal: Tapejung-Heydewa-Garhi Dama, *Hara & al.* 631818.

Bhutan: Near Punakka, *Griffith* 2081.

China: Poneshee (Yunnan Expedition), 26 Mar. 1868, *Anderson s.n.*

**2b. var. griffithiana** (Decne.) Ghora in Bull. Bot. Surv. India 47(1-4): 149-150. 2005.

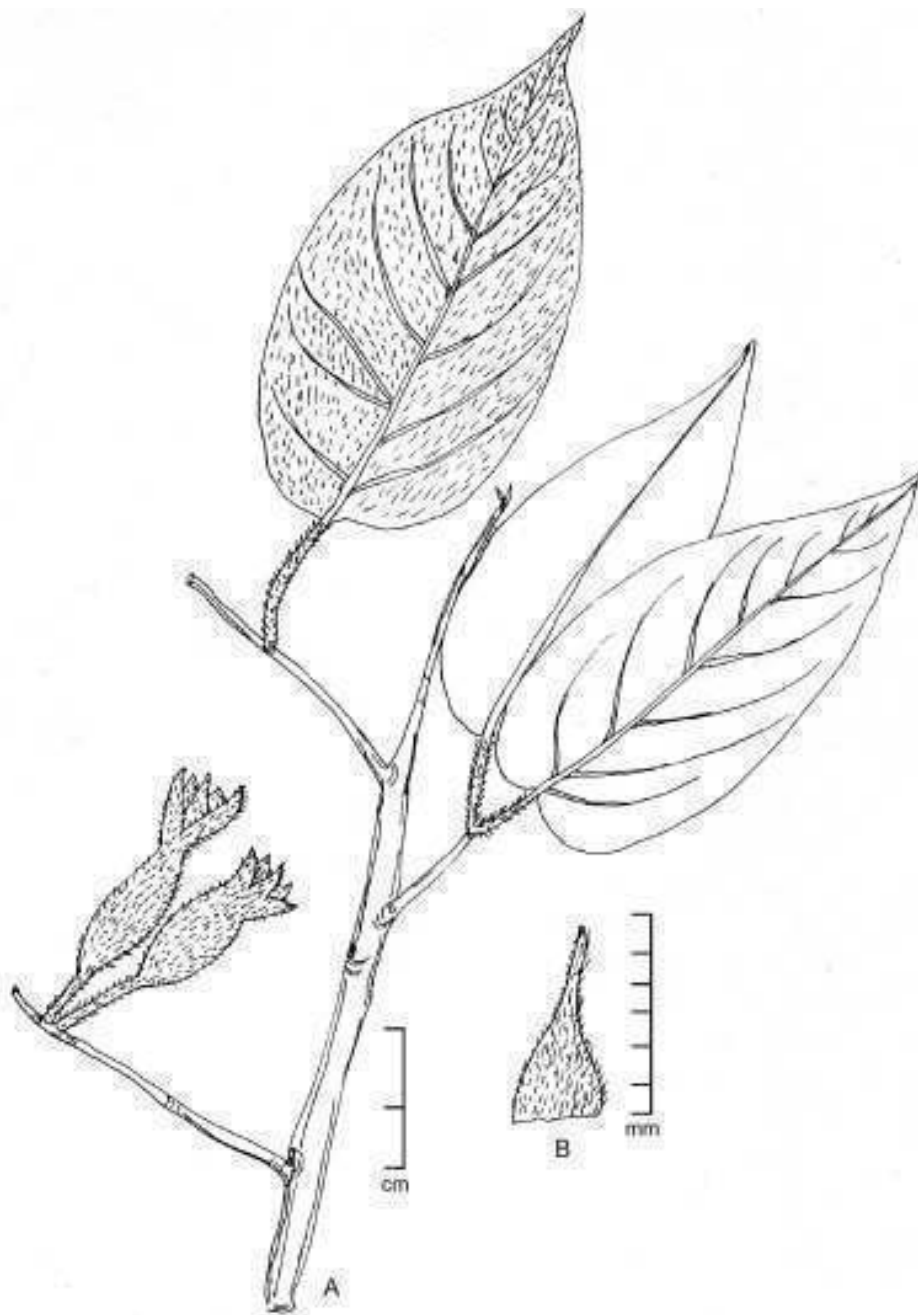
*Docynia griffithiana* Decne. Nouv. Arch. Mus. Paris, 10: 131. 1874.

(Fig. 2)

*Type*: Himalaya Oriental, *Griffith* 2082 (Holotype-K. photo CAL ! Isotype- East Himalaya, Bhutan, *Griffith* 2082 (CAL acc. no. 153663 !).

Tree erect, 3 to 7 m high; branches tomentose, leaves 9-12 × 3-4 cm, base cuneate, apex long acuminate, margin entire, repand, sometimes crenate in apical part, glabrous above, tomentose beneath on veins only; petioles 2-3.5 cm long, tomentose. Stipules 6 × 1 mm, linear, woolly on both surfaces. Inflorescence umbel, usually 2-3-flowered. Bracts 5-6 × 1 mm, linear. Flowers pedicellate. Hypanthia globose. Sepals 5, 10-13 × 3-4 mm, lanceolate, villose on both surfaces. Petals 5, 15-20 × 10-11 mm, obovate, white. Stamens up to 50, filaments 7-8 mm long. Styles 5, 9-10 mm long, woolly from base to half, united at base. Ovary woolly. Pome 1.5-1.8 × 2-5 cm, globose, pubescent to puberulous, glabrous at maturity, 5-celled, cells 3-seeded.





**Fig. 2.** *Docynia indica* (Wall.) Decne. var. *griffithiana* (Decne.) Ghora.: A. Habit; B. Sepal :  
[G. Watt. 6781 (CAL. acc. no.153586)]

*Flowering & Fruiting* : Feb.-Dec.

*Distribution*: India (Manipur, West Bengal); Bhutan.

*Representative specimens examined* : Manipur: Ligli village, 1520 m, 7 Jan. 1882, G. Watt 5052 (CAL acc. no. 153585); Khongui valley, 1216-1520 m, 27 Apr. 1882, G. Watt 6781 (CAL acc. no. 153586).

West Bengal: Darjeeling Lloyd Botanic Garden, 1976 m, 17 Apr. 1961, Indo-Russian Expedition to E. Himal. & N. Bengal, *s.l.* 118(CAL).

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## भारत में वंश *डोसिनिआ डेक्ने* (रोजेसी) का पुनरीक्षात्मक अध्ययन

छवि घोरा

### सार संक्षेप

भारत में वंश *डोसिनिआ डेक्ने* (1874) (रोजेसी) के तीन टैक्सा : *डोसिनिआ हुकरिएना डेक्ने*, *डोसिनिआ इंडिका डेक्ने*, *डोसिनिआ इंडिका* प्रभेद *ग्रिफिथिएना* (डेक्ने) का पूर्वी हिमालय से पुनरीक्षात्मक अध्ययन में उनके प्ररूप, वर्णन, नमूनों के अध्ययन आदि प्रस्तुत किए गए हैं।

## SYSTEMATIC STUDIES ON FAMILY COMMELINACEAE OF SIKKIM

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### ABSTRACT

The present paper deals with the detailed taxonomic treatment of the family Commelinaceae comprising of 8 genera and 25 species in Sikkim. A key to the genera and species based on the morphological characters is also given for easy identification. *Streptolirion volubile* subsp.  *khasianum* (C.B.Clarke) D.Y. Hong is reported for the first time from Sikkim.

**Keywords :** Biogeography, Commelinaceae, Morphology, Systematics, Sikkim.

### INTRODUCTION

The family Commelinaceae commonly known as the Spiderwort family consists of 40 genera and 600 species (Mabberley 2008). The members of the family are mainly distributed in the tropical, subtropical and subtemperate regions of Northern hemisphere. Several species of *Commelina*, *Tradescantia*, *Zebrina* are cultivated due their ornamental value or as in house plants.

The family was studied by several taxonomists like Bruckner (1930), Hutchinson (1934,1973), Woodson (1942), and Pichon (1946). Bruckner and Pichon segregated the genera on the basis of perianth structure. Woodson and Hutchinson segregated the genera according to the type of inflorescence. The Indian members of the family were studied by Hassk. (1870); Panigrahi (1975); Santapau (1955); Rao (1964, 1966, 1971). Kammathy & Rao (1962,1965) and Rao & al. (1968) studied the cytology of the members of the family. The chromosome pattern and evolutionary trends were studied by Rao & al. (1972).

The state of Sikkim is situated in the eastern Himalaya between 27°5'– 28°9'N lat. and 87° to 89° E long. The state has a total geographic area of 7096 sq. km. and elevation ranges from 250m to 8598m. Its unique geographic position, varied range of altitude and topography with high annual precipitation has made this state one of the richest botanical areas of the country. The state is endowed with 42.8 % of the area under forest and c.4500 species of flowering plants, i.e. 26% of Indian flora (Dash & Singh 2002).

In Sikkim, the family Commelinaceae is represented by 8 genera, 25 species and 2 subspecies. No systematic study of the family Commelinaceae of Sikkim is available. Hooker (1892), Mitra (1952), Hara & al. (1982) and Noltie (1994) provided only a sketchy references of the species occurring in the state. In the present paper, key to genera and species is given to facilitate their identification. All the genera are arranged alphabetically. Within the genera the species are also arranged alphabetically. Description of all genera is given. For each species detailed citations, description, phenology, field note and specimens examined are provided.

### MORPHOLOGY

Morphology plays an important role for segregating the genera and particularly the species of Commelinaceae of Sikkim. Description of the morphological characters is based on the field observations and on herbarium specimens housed in Sikkim (BSHC).

#### *Habit*

All the members of Commelinaceae found in Sikkim are invariably herbs or undershrubs, except *Streptolirion* which is having a climbing habit. The stem is variable from decumbent to ascending and scandent. In *Commelina*, the stem is often swollen at nodes and develop conspicuous adventitious roots. Stems are variously pubescent, ciliate or glabrous.

### Leaves

Generally the leaves are alternate, entire and simple. Two types of leaves are found, basal and upper (cauline). Basal leaves are found in *Commelina*, *Cyanotis*, *Murdannia* and *Streptolirion*. The shape and size of the leaves are variable from linear-lanceolate to elliptic to oblanceolate. In *Streptolirion*, the leaves are ovate-cordate while in *Amischotolype* they are elliptic.

### Inflorescence

Inflorescence is fundamentally of two types, cymose (determinate) or racemose (indeterminate). Both the types are present in same genus also. Flowers are mostly pedicellate and subtended by a spathe like bract. Inflorescence is of thyriform racemes in *Streptolirion*, *Commelina*, *Floscopa* and *Rhopalephora*, while it is of terminal globose heads in *Amischotolype*. In *Cyanotis* it may be unbranched helicoid cymes. In *Murdannia* and *Polia* it is branched or unbranched subumbellate one flowered thyriform panicles.

The flower bearing stem is not sharply distinguished from the vegetative shoot except in *Polia* and *Streptolirion*. In both the genera, the inflorescence is thyriform, in which flowers are deflexed after anthesis. Spathes may be conduplicate or funnel shaped in *Commelina* or sickle shaped in *Cyanotis*. Leafy spathes are found in *Floscopa* and *Polia* while in *Rhopalephora* the spathes are funnel shaped with oblique free ends.

### Flowers

Both unisexual and bisexual flowers are found in family Commelinaceae. In *Streptolirion* and *Commelina*, the flowers are bisexual and when unisexual then only with male flowers. The flowers are trimerous, but in *Murdannia* and *Cyanotis* they are either modified by suppression or fusion of parts. Flowers are hypogynous. Flowers are occasionally cleistogamous in *Commelina*. The flowers are diploclamydeous and the number of tepals are 2-3. The reduction in perianth number may be due to fusion, which is very rarely found in some members of *Commelina*. Stamens in the family Commelinaceae are in two whorls. Reduction of any number may be in either of whorls. However, the outer whorl fluctuates considerably. The total number of stamens ranges from 3-6, even in the single genus. The filament length is variable. Ovary is superior, 2-3 celled with one locule indehiscent.

### Fruits

Fruits are loculicidal capsule with 2-3 locules. Seeds are prismatic, dorsiventrally compressed and bearing a circular boss. All the members having a median boss except *Streptolirion*, where the position is apical.

## BIOGEOGRAPHY

There are no species found endemic to the state. Out of 25 species, 13 (52%) species show distribution in almost all regions of the country with an eastern range up to Vietnam and western range up to Pakistan. Only 3 species viz. *Amischotolype hookeri*, *Streptolirion volubile* and *Polia hassakarlii* are restricted in distribution in eastern himalaya and NE region of the country. *Polia subumbellata* shows a disjunct distribution in the eastern Himalaya, NE India and Western ghats, while *Rhopalephora scaberimma* is distributed in eastern Himalaya, NE India, peninsular India and south of eastern ghats of India. Almost all species are showing their distribution common to both eastern and western himalayas. Twenty three species are found in NE India while as many as 16 species show their distribution in peninsular India. Members of the family Commelinaceae show a wide range of distribution in Sikkim. The species are restricted in between tropical to subtropical regions of the state. *Commelina* and *Cyanotis* are the only two genera which show a distribution in the temperate regions of the state.

Species found in Sikkim show a wide range of distribution in other parts of the world. About 84% of species which are found in Sikkim are common to China except four species, viz., *Amischotolype glabrata*, *Commelina coroliniana*, *Commelina sikkimensis* and *Cyanotis fasciculata*; 40% of species shows their range up to Pakistan (Table – I).

**Table I : Distribution pattern of the family Commelinaceae of Sikkim in other parts.**

Name of the Species	W. Himalaya (Himachl, J&K)	E. Himalaya (Nepal, Bhutan)	NE India	Peninsular India	W. Ghats/ W. India	North India (Rajasthan, UP, Delhi)	Central India ( M.P., Chattisgagh)	East India (W.B., Orissa)	Pakistan	China	Eastern Limit
<i>Amischotolype hookeri</i>	x	√	√	x	x	x	x	x	x	x	Vietnam
<i>Amischotolype mollissima</i>	x	√	√	√	x	x	x	x	x	x	Bhutan
<i>Commelina benghalensis</i>	√	√	√	√	√	√	√	√	√	√	China
<i>Commelina diffusa</i>	x	√	√	√	√	x	√	√	x	x	China
<i>Commelina coroliniana</i>	√	√	√	√	√	√	√	√	√	√	Vietnam
<i>Commelina maculata</i>	√	√	√	√	√	√	√	√	√	x	China
<i>Commelina paludosa</i>	x	√	√	x	x	x	√	x	x	x	China
<i>Commelina sikkimensis</i>	x	√	√	x	x	x	x	x	x	x	Bhutan
<i>Commelina suffruticosa</i>	x	√	√	x	√	x	√	√	x	x	China
<i>Cyanotis arachnoidea</i>	x	√	x	√	x	x	√	x	x	x	Vietnam
<i>Cyanotis axillaris</i>	√	√	√	√	√	√	√	√	√	x	Vietnam
<i>Cyanotis cristata</i>	x	√	√	√	√	√	√	√	√	x	Vietnam
<i>Cyanotis fasciculata</i>	√	√	√	x	x	x	√	√	x	x	Bhutan
<i>Cyanotis vaga</i>	x	√	x	x	x	x	x	√	x	x	Bhutan
<i>Floscopa scandens</i>	x	√	√	√	√	√	x	√	√	√	Vietnam
<i>Murdannia divergens</i>	x	x	√	√	x	x	x	√	x	√	China
<i>Murdannia edulis</i>	√	√	√	√	√	√	√	√	√	√	Malaysia
<i>Murdannia japonica</i>	√	√	√	√	√	√	√	√	√	√	China
<i>Murdannia nudiflora</i>	√	√	√	√	√	√	√	√	√	√	China
<i>Murdannia spirata</i>	√	√	√	√	√	√	√	√	√	√	China
<i>Murdannia vaginata</i>	√	√	√	√	√	√	√	√	x	√	Vietnam
<i>Polia hasskarlii</i>	x	√	√	x	x	x	x	x	x	√	China
<i>Polia subumbellata</i>	x	√	√	x	√	x	x	x	x	√	China
<i>Rhopalephora scaberrima</i>	x	√	√	√	x	x	x	x	x	√	China
<i>Streptolirion volubile</i>											
subsp. <i>volubile</i>	x	√	√	x	x	x	x	x	x	√	Japan
subsp. <i> khasianum</i>	x	√	√	x	x	x	x	x	x	√	China

√ : Occur in the region; x does not occur in the region.

### ECONOMIC IMPORTANCE

Species of Commelinaceae are used for fodder and vegetables in the traditional pattern among rural as well as urban populations. *Commelina benghalensis* is used as laxative, emollient and demulcent. Leaves of *Floscopa scandens* are used as fodder, in bone fractures, while the root of the same plant is used as febrifuge against chronic cough and cold. Leaves of *Murdannia nudiflora* used as pot herbs and as a poulticing agent against boils, itches and burns. Roots of *Cyanotis arachnoidea* are reported to be used for stimulating blood circulation and as a muscle relaxant.

## SYSTEMATIC TREATMENT

## COMMELINACEAE

Annual or perennial herbs, sometimes tuberous; stems erect or decumbent, rooting at nodes, usually with a line of hairs. Leaves alternate, distichous, lanceolate, ensiform, narrowed to petiole like leaf-base, sheaths prominent, open or closed, margins hairy. Inflorescence terminal or axillary cymose, sometimes solitary flower, supported by a membranous spathe. Flowers bisexual, hypogynous, trimerous, sepals 3, persistent; petals 3, ephemeral, 2 similar, broadly ovate, one smaller or absent, lanceolate, stamens in two whorls of 3 each, one of the whorls sometimes sterile or bearing staminodes, filaments glabrous or hairy, ovary 2-3-locular, placentation axile; styles filiform. Fruits a loculicidal capsule. 2 – 3 loculed, one locule sometimes indehiscent. Seeds usually prismatic, dorsiventrally compressed, bearing a circular boss.

c. 40 genera and 600 species distributed from tropical to subtemperate regions (Mabberley 2008); 14 genera and 84 species in India (Karthik. & al. 1989); 8 genera, 25 species and 2 subspecies in Sikkim.

- |   |                         |
|---|-------------------------|
| 1a. Climbing herbs; inflorescences cincinnus covered by a involucre bract       | 8. <i>Streptolirion</i> |
| 1b. Prostrate or erect herbs; inflorescences simple or helicoid cymes           | 2                       |
| 2a. Inflorescence penetrating leaf sheath, capitate; fertile stamens 6          | 1. <i>Amischotolype</i> |
| 2b. Inflorescence not as above, fertile stamens 6 or less                       | 3                       |
| 3a. Fruits indehiscent, baccate, bluish; petals usually white                   | 6. <i>Pollia</i>        |
| 3b. Fruits dehiscent, capsular, brown or blackish; petals blue                  | 4                       |
| 4a. Filaments with glandular hooked hairs; upper petals clawed, bluish          | 7. <i>Rhopalephora</i>  |
| 4b. Filaments glabrous; upper petals simple                                     | 5                       |
| 5a. Inflorescence in racemes, terminal, many flowered, capsules 2-valved        | 4. <i>Floscopa</i>      |
| 5b. Inflorescence in cymes, lateral, few flowered, capsules 3-valved            | 6                       |
| 6a. Stamens 6, all perfect; petals connate below                                | 3. <i>Cyanotis</i>      |
| 6b. Stamens 3-6, staminodes 3, bright coloured, petals free                     | 7                       |
| 7a. Involucre bracts spathe-like; staminodes 4-lobed, fimbriate, butterfly like | 2. <i>Commelina</i>     |
| 7b. Involucre bract spreading; staminodes 3-lobed, sagittate                    | 5. <i>Murdannia</i>     |

## 1. AMISCHOTOLYPE HASSK.

Erect herbs; stems rooting at lower nodes; rhizomes long. Leaves elliptic; sheath tubular, persistent. Inflorescences capitate or globose fascicled cymes, always subtended by a membranous bract. Sepals 3, subequal, free; petals 3, subequal; stamens 6, all perfect, filaments beaded; anthers ovoid, ovary 3 celled, each bearing 1 or 2 superimposed ovules. Seeds with long linear hilum, rugose, covered by a red aril.

c. 15 species distributed in Old world, Europe (Mabberley 2008); 3 species in India (Karthik. & al. 1989); 2 species in Sikkim.

- |   |                       |
|---|-----------------------|
| 1a. Capsule oblong, hairy all over, larger than sepals                  | 1. <i>A. hookeri</i>  |
| 1b. Capsules globose, densely long hairy near apex, shorter than sepals | 2. <i>A. glabrata</i> |

***Amischotolype hookeri*** (Hassk.) H. Hara, Fl. E. Himal. 399. 1966; Karthik. & al., Fl. India. Enum. Monocot. 23.1989; Noltie, Fl. Bhutan 3(1): 223. 1994. *Forrestia hookeri* Hassk. in Flora 47:629.1864; Hook. f., Fl. Brit. India 6: 384. 1892.

Herbs; stems ascending, Leaves elliptic-oblong, 14-25 x 5-8 cm, caudate-acuminate at apex, cuneate at base, margin minutely ciliate, densely appressed yellowish hairy beneath, glabrous above; leaf sheath overlapping, widely cylindrical, densely brownish hairy. Inflorescence in cymose heads, shortly peduncled, up to 10-flowered. Flowers white; sepals oblong, 4-7 x 2-5 mm, keeled, glabrous; petals oblong, equaling to or slightly longer than sepal; stamens 6, all fertile, filaments c. 8 mm long, bearded with jointed hairs; anthers 2 mm long; ovary trigonous. Capsules oblong-lanceolate or narrowly ellipsoid, much exceeding the persistent sepal, 10-12 x 5-7 mm, acute at apex, sparsely brown hairy, 3 locular, 2 locules with 2 seeds and one locule with 1 seed. Seeds rugose.

*Flowering & Fruiting* : May – October.



**Fig. 1.** A. *Commelina benghalensis*. B. *Commelina paludosa*. C. *Commelina sikkimensis*. D. *Commelina coroliniana*. E. *Commelina diffusa*. F. *Commelina maculata*.



*Field notes:* Scattered on moist areas, broad leaved forests, 120-1200 m.

*Specimens examined:* Sikkim, Hooker s.n. (CAL).

**Amischotolype mollissima** (Blume) Hassk. in Flora 46: 392.1863; Karthik. & al., Fl. India. Enum. Monocot. 23.1989. *Campellia mollissima* Blume, Enum. Pl. Jav. 1: 7. 1827. *Amischotolype glabrata* (Hassk.)Hassk. in Flora 46: 392. 1863; Noltie, Fl. Bhutan 3(1): 224. 1994. *Forrestia glabrata* (Hassk.)Hassk. in Flora 47: 630. 1864; Hook. f., Fl. Brit. India 6: 384. 1892.

Herbs perennial, stems erect, c. 1 m high, creeping and rooting below. Leaves elliptic, 8-27 x 3.5-8 cm, caudate-acuminate at apex, entire, base narrowed to a petiole, glabrous, ciliate towards base, petioles densely hairy with golden or whitish hairs; sheath 2-3.5 cm long, ciliate at mouth. Inflorescence in axillary dense umbels, 1-10-flowered. Flowers white, subtended by a lanceolate membranous white sessile bracteole; sepals oblong, 1-5 mm, glabrous, densely hairy towards apex and margin; petals sub-equal, stamens 6, all perfect, filaments beaded; anthers ovoid, ovary 3-celled. Fruits equaling or smaller than sepals, trigonous, 3-valved, mucronate with persistent style, densely hairy towards the apex turns red at maturity. Seeds 2 in each cells, seeds oblong, rugose.

*Flowering & Fruiting* : June – October.

*Field notes:* Common on marshy grounds, 500 – 1500 m.

*Specimens examined:* Bijan Bari, N.R. Mandal 11729 (BSHC), Namnasa, N.R. Mandal 11231(BSHC).

## 2. COMMELINA L.

Herbs, stem creeping and ascending. Leaves lanceolate or oblong-elliptic, with a loose sheath. Inflorescence few flowered cymes, enclosed in a conduplicate or funnel shaped spathe, upper cymes deciduous or continue only with male flowers, inner cymes with bisexual flowers, pedicels sharply recurved and thickened in fruit. Sepals 3, membranous, outer one free, two inner sepals often connate below; petals 3, longer than sepals, two clawed and one lanceolate; stamens 3 perfect; anthers oblong, two lateral anthers similar, medial anther larger, imperfect stamens 2-3; antheroids small, fimbriate; ovary 2-3-celled. Capsules 3-celled, two cell loculicidal and third cell indehiscent. Seeds ellipsoid, smooth or rugose.

c. 170 species distributed in tropical and warmer regions (Mabberley 2008); 24 species in India (Karthik.& al. 1989); 7 species in Sikkim.

- |   |                           |
|---|---------------------------|
| 1a. Leaves elliptic-ovate, underground cleistogamous flower are present   | 1. <i>C.benghalensis</i>  |
| 1b. Leaves lanceolate; underground cleistogamous flowers never present  | 2                         |
| 2a. Capsules 3-celled; seeds one per locule; spathe connate along the margin, funnel shaped   | 3                         |
| 2b. Capsules 2-3-celled, anterior locules of capsules 2-seeded, posterior locule one seeded, spathe open along the margin, conduplicate | 4                         |
| 3a. Plant robust; leaves 13 cm long or more; leaf sheath mouth densely brown-hirsute  | 5. <i>C. paludosa</i>     |
| 3b. Flaccid herbs; leaves less than 7 cm long, leaf sheath mouth glabrous or sparsely ciliate   | 4. <i>C. maculata</i>     |
| 4a. Capsules 2-locular, involucre bract cordate   | 7. <i>C. suffruticosa</i> |
| 4b. Capsules 3-locular, involucre bract rounded   | 5                         |
| 5a. Seeds smooth, without surface reticulation  | 2. <i>C. coroliniana</i>  |
| 5b. Seeds rugose, with surface reticulation   | 6                         |
| 6a. Leaves and spathe finely acuminate, seed reticulation deeply grooved  | 6. <i>C. sikkimensis</i>  |
| 6b. Leaves and spathe acute, seed reticulation without groove   | 3. <i>C. diffusa</i>      |

**1. Commelina benghalensis** L., Sp. Pl. 41. 1753; Hook. f., Fl. Brit. India 6: 370. 1892; H. Hara, Fl. E. Himal. 399. 1966; Karthik. & al., Fl. India. Enum. Monocot. 24.1989; Noltie, Fl. Bhutan 3(1): 238. 1994.

Herbs perennial; stems 15-80 cm long, rooting at nodes. Leaves ovate or elliptic-ovate, 2-9 x 0.7-3.5 cm, rounded or obtuse at apex, entire, margin densely ciliate, base rounded, contracted to a short petiole, pubescent with whitish hairs; leaf sheath funnel shaped, 0.5-1.5 cm long, pubescent or villous, mouth ciliate with jointed hairs. Spathe 1-3, c. 1 x 1 cm, terminal, funnel shaped, densely villous, margin fused. Cymes 2, one



with 2-3 flowers and other with single flower, exserted shortly. Outer single flower male, occasionally bisexual. Flowers blue; petals 3, 2-clawed, oblong-ovate, *c.* 4 x 5 mm, one lanceolate, *c.* 4 x 1.5 mm; stamens 3, perfect; filaments unequal, *c.* 6 mm long; median anther longer than lateral anthers; ovary *c.* 2 x 1 mm, styles *c.* 6 mm long, coiled at apex. Capsules oblong, 3-celled, anterior cells with 2 seeds, dehiscent, posterior cell with 1 seeded, indehiscent. Seeds rugose, paired seeds truncate at common end, brown, boss *c.* 1 mm long.

*Flowering & Fruiting* : July – October.

*Field notes*: Scattered on moist places, 300 – 1800 m.

*Specimens examined*: Namak, *N.R.Mandal* 10146 (BSHC); Machung, *N. R. Mandal & P. Singh* 13471(BSHC); Gangtok, *N. R. Mandal* 7277 (BSHC); Rangpo, *N. R. Mandal* 11902(BSHC).

- 2. *Commelina coroliniana*** Walter, Fl. Carol. 68.1788. *Commelina hasskalii* C. B. Clarke, Commelyn. Cyrt. and Bengal. 13, t. 5:1874. 1892; in Hook. f., Fl. Brit. India 6: 370. 1892; H. Hara, Fl. E. Himal. 400. 1966; Karthik. & al., Fl. India. Enum. Monocot. 25.1989

Herbs, annual; stems trailing, grooved, glabrous, much branched from the base. Leaves narrowly lanceolate, upper leaves larger, lower leaves smaller, 3-6 x 0.7-1.5 cm, rounded at base, entire, subacute at apex, granulose on upper surface, glabrous on lower surface; leaf sheath 1-1.5 cm long, glabrous, brown, mouth and margin ciliate. Inflorescence cincinnus, usually 2, upper 2-4 flowered, lower 1-3 flowered. Flowers blue; involucral bract conduplicate, *c.* 2.5 cm long, ovate-lanceolate, cordate at base, acute at apex; sepals ovate-lanceolate; petals obovate, clawed. Capsules ellipsoid-oblong shortly beaked, 3-celled. Seeds 2 in larger cells and 1 with a undeveloped seeds brown-black, acute on one end, truncate on other end, smooth; hilum linear, *c.* 4 x 1 mm.

*Flowering & Fruiting* : August – December.

*Field notes*: Common on marshy places, 800 – 1500 m.

*Specimens examined*: East: Sichey basty Gangtok, *N.R. Mandal*, 13741 (BSHC).

- 3. *Commelina diffusa*** Burm. f., Fl. Indica. 18. 1768; R.S. Rao in Notes Roy. Bot. Gard. Edinburgh 25: 179. 1964; H. Hara Fl. E. Himal. 400. 1966; Karthik. & al., Fl. India. Enum. Monocot. 23.1989; Noltie, Fl. Bhutan 3(1): 237. 1994. *Commelina nudiflora sensu* Hook. f., Fl. Brit. India 6: 369. 1892; *non* L. 1753.

Herbs, annual, stems trailing, glabrous. Leaves lanceolate, 3-7 x 1-1.5 cm, acuminate at apex, entire, base rounded, glabrous; leaf sheath membranous, *c.* 1-3 cm long, whitish, hispid, mouth ciliate, red spotted. Spathe *c.* 2 cm long, conduplicate, acuminate, glabrous, base slightly cordate. Inflorescence in paired cymes; peduncles *c.* 1.5 cm long, outer with exserted peduncle and male flowers, inner 2-3 bisexual flowers. Sepals lanceolate, 4-5 mm; petals clawed, orbicular; perfect stamens 3, filaments *c.* 5 mm long; ovary trigonous. Capsules 3-celled, 3-seeded. Seeds rugose; hilum linear, blackish, marked with surface reticulation.

*Flowering & Fruiting* : April – September.

*Field notes*: Common on shady moist and stream sides, rice fields, 300-1800m.

*Specimens examined*: Simbar-Namchi *N.R. Mandal* 14741, 14703(BSHC); Tendong R.F., *A.K. Verma* 6763 (BSHC); Melli, *B.K. Shukla* 18790 (BSHC); Tareng to Dead Khola, *N.R. Mandal* 1359, 11342 (BSHC).

- 4. *Commelina maculata*** Edgew. in Trans. Linn. Soc. London 20: 89. 1846; Karthik. & al., Fl. India. Enum. Monocot. 25.1989. *p.p.* ; Noltie, Fl. Bhutan 3(1): 235. 1994. *Commelina obliqua* Buch.-Ham. ex D.Don var. *viscida* (C. B. Clarke) R.S.Rao & Kammathy in Bull. Bot. Surv. India 3: 168.1962 (1961).

Herbs, perennial, stems creeping, branched, 10-40 cm long, minutely hairy, usually with a line of reflexed hairs. Leaves lanceolate, 2.5-7 x 1-2.5 cm, acuminate at apex, entire, rounded or oblique at base, upper surface pubescent; leaf sheaths conical, 0.8-1.5 cm, brown hairy, mouth with jointed brownish cilia. Spathe 1-2, *c.* 1 x 1 cm, funnel shaped, glabrous or very minutely hairy towards the acute apex. Flowers pale blue, 4 in a spathe, pedicels *c.* 4 mm long; sepals 3, oblong, 4 x 3 mm; petals 3, anterior petals clawed, *c.* 6 x 7 mm,

lanceolate, posterior petals smaller; stamens 4, perfect; anthers 8-10 mm long, brightly yellow, filaments coiled, 6-8 mm long, antheroids 2, globose; style recurved at top, c. 7-8 mm long. Capsules 2-4 x 2-4 mm, 3-locular, 1-seeded in each locule. Seeds elliptic, sparsely papillose.

*Flowering & Fruiting* : June – October.

*Field notes*: Common in marshy fields; agricultural fields and open areas; 500 – 3000 m.

*Specimens examined*: Gangtok, *N.R. Mandal* 13740, 9919 (BSHC); Yumthang to Lachung, *N.R. Mandal* 10113, 10115 (BSHC); Chungthang, *N.R. Mandal* 10074 (BSHC); Bay, *N.R. Mandal* 10584, 11090 (BSHC).

- 5. *Commelina paludosa*** Blume, Enum. Pl. Java. 1: 2. 1827; R. S. Rao in Notes Roy. Bot. Gard. Edinburgh 25: 181. 1964; H. Hara, Fl. E. Himal. 400. 1966; Noltie, Fl. Bhutan 3(1): 235. 1994. *Commelina obliqua* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 45. 1825; *non* Vahl, 1806; Hook. f., Fl. Brit. India 6: 372. 1892.

Herbs, perennial, stems robust, erect, 50-150 cm long, glabrous, much branched. Leaves lanceolate, 7-22 x 2-5.6 cm, acuminate or caudate-acuminate at apex, entire, base cuneate, glandular above, glabrous and glandular beneath; leaf sheaths tubular, 1.5-3 cm long, pubescent along the margin, mouth densely ciliate with brown cilia. Spathe terminal, subsessile or minutely stalked; funnel shaped. Cymes single, 4-7 flowered, occasionally exserted from spathe. Sepals oblong-ovate, 5-4 mm long; petals 3, unequal, 2 oblong-elliptic, c. 8 x 9 mm, one lanceolate 7 x 2 mm; stamens 6, perfect 3; staminodes 3, filaments 6 mm long, anthers bright yellow, ellipsoid, antheroids 1.5 mm, filaments coiled, 9-10 mm long; ovary trigonous, c. 0.7 x 0.5 mm long, style recurved at apex, 7-9 mm long. Capsules oblong, truncate at base, 3-valved, one seed in each locule. Seeds dark brown, c. 4 x 2 mm, minutely glandular, boss 0.5 - 1 mm across.

*Flowering & Fruiting* : June – October.

*Field notes*: Common on moist and grassy slopes, stream sides; 200 – 1850 m.

*Specimens examined*: Gangtok, *N.R. Mandal*, 13724, 7281 (BSHC); *S.S. Dash* 24035 (BSHC); Lingya, *B. Mitra* 6881 (BSHC); Mangan, *N.R. Mandal* 11847 (BSHC); Namchi, *R.C. Srivastava* 10976 (BSHC); Kewsing, *N.R. Mandal* 13730 (BSHC).

- 6. *Commelina sikkimensis*** C.B. Clarke, Commel. & Cyrt. Bengal. t. 6: 1874 & in A. DC. & C. DC. Monogr. Phan. 3: 147. 1881; Hook. f., Fl. Brit. India 6: 367. 1892; Karthik. & al., Fl. India. Enum. Monocot. 25. 1989. Noltie, Fl. Bhutan. 3(1): 236. 1994.

Herbs, annual; stems trailing, ascending, 50-180 cm high, glabrous or minutely pubescent. Leaves lanceolate or ovate-lanceolate, 3-9 x 0.7-2.5 cm, sessile, rounded at base, entire, acuminate at apex, puberulous on upper surface, glabrous on lower surface; leaf sheath 2-3 cm long, mouth long ciliate, red spotted throughout. Inflorescence in short cymes, usually 2, outer exserted from spathe, with 2-4 male flowers, inner enclosed, with bisexual flowers; spathe ovate-lanceolate, 3.5-4 cm long, acuminate. Sepals ovate-lanceolate, 5 x 2 mm; petals blue, 3, anterior 2 clawed, c. 3 x 4.5 mm orbicular, posterior petal smaller, lanceolate; perfect stamens 3, median longer than lateral; anther c. 1.2-2 mm long; antheroids curved; filaments c. 1 mm; ovary ellipsoid-trigonous, 4 x 1.5 mm; styles filiform, 6-8 mm. Capsules oblong-ellipsoid, two locules dehiscent with 2 seeds each, one locule indehiscent, 1 seeded; seeds rugose, with deeply pitted reticulation, boss c. 1 mm across.

*Flowering & Fruiting* : August – November.

*Field notes*: Common on marshy, open and streamside, 750-2300m.

*Specimens examined*: Machung gumba, *N.R. Mandal & P. Singh* 13407 (BSHC), Sichey-Gangtok, *N. R. Mandal & S.K. Rai* 9934 (BSHC); Namak to Dikchu, *N.R. Mandal*, 11288 (BSHC); Lingu, Pentong, *N.R. Mandal* 11128 (BSHC); Dentam, *P. Singh* 16370 (BSHC); Samsar, *N.R. Mandal* 14706 (BSHC).

- 7. *Commelina suffruticosa*** Blume, Catalogus 35. 1823; Hook. f., Fl. Brit. India 6: 374. 1892; Karthik. & al., Fl. India. Enum. Monocot. 26. 1989; Noltie, Fl. Bhutan 3(1): 236. 1994.

Herbs; stems 10-40 cm long, terete, much branched at nodes, nodes swollen. Leaves lanceolate, 4-12 x 1.5-2.5 cm, acuminate at apex, entire, base cuneate or rounded, occasionally oblique, pubescent on both sides, more along the veins; sheaths tubular, scabrid, mouth ciliate with black jointed hairs. Inflorescence in terminal single cymes, 7-8-flowered; spathe funnel shaped, covered by two opposite leaves, acute, densely hairy. Flowers white or pale blue; anterior petals 2, clawed, *c.* 3 x 2 mm, posterior petals lanceolate, *c.* 2 x 1 mm; perfect stamens 3; filaments *c.* 6 mm long; anthers subequal; ovary trigonous; styles *c.* 3 mm long, recurved at apex. Capsules oblong, compressed, 4-6 x 6-8 mm, 2-locular, 1-seeded each; seeds minutely papillate, 4 x 3 mm, boss 1 mm across.

*Flowering & Fruiting* : June- December.

*Field notes*:: Scattered in moist and shady localities, 300 – 1850 m.

*Specimens examined*: Pentong, *N.R. Mandal* 11086 (BSHC); Chungthang, *N.R. Mandal* 10046 (BSHC); Gangtok, *N.R. Mandal* 13724 (BSHC).

### 3. CYANOTIS D. DON (nom. cons.)

Herbs, perennial or annual; stems prostrate or decumbent, pubescent along the lateral line, otherwise glabrous. Inflorescence in terminal helicoid cymes, subtended by spathe like involucre bract; bracts falcate, imbricating. Sepals subequal, free or connate below; petals united into a tube below, lobes free in upper portion; stamens 6, all perfect; filaments with beaded hairs; anthers oblong; ovary 3-locular, each with 2 axile ovules; styles filiform, often with beaded hairs. Capsules 3-valved, loculicidal. Seeds superposed, cuboid or conical, rugose, boss apical.

*c.* 50 species distributed in Old World tropics (Mabberley 2008); 16 species in India (Karthik. & al. 1989); 5 species in Sikkim.

- |   |                          |
|---|--------------------------|
| 1a. Flowers all in axils of leaf- sheath                            | 2. <i>C. axillaris</i>   |
| 1b. Flowers are in conspicuous terminal cymes                       | 2                        |
| 2a. Leaves oblong- lanceolate, margins densely ciliate              | 3. <i>C. cristata</i>    |
| 2b. Leaves linear-lanceolate or linear-oblong, leaf margin glabrous | 3                        |
| 3a. Bracts hairy or glabrous, if hairy silky arachnoid hairs absent | 5. <i>C. vaga</i>        |
| 3b. Bracts hairy with silky arachnoid hairs                         | 4                        |
| 4a. Flacid herbs, roots bulbous, seeds conspicuously pitted         | 4. <i>C. fasciculata</i> |
| 4b. Robust herbs, roots tuberous, seeds obscurely pitted.           | 1. <i>C. arachnoidea</i> |

**1. Cyanotis arachnoidea** C. B. Clarke, in A. DC. & C. DC., Monogr. Phan 3: 250.1881; Hook. f., Fl. Brit. India 6: 386. 1892; Karthik. & al., Fl. India. Enum. Monocot. 25.1989.

Herbs, perennial; stems decumbent, glabrous, 15 – 70 cm long, rooting at nodes; roots fibrous. Leaves linear – oblong or lanceolate, ensiform, 1-6 x 0.5-1.5 cm, acuminate at apex, attenuate at base to a leaf sheath, minutely silky pubescent (arachnoid) beneath; leaf sheath *c.* 1 cm long. Flowers in axillary or terminal cymes, usually subtended by a leafy spathe; bracteoles lanceolate, minutely pubescent; sepals linear-lanceolate, *c.* 4 x 1 mm, ciliate at margin; petals oblong, *c.* 3 x 1.5 mm; stamens 6, filaments blue arachnoid; ovary 3-celled; style bearded and thickened below. Capsules oblong. Seeds elongate, obscurely pitted.

*Flowering & Fruiting* : July –October.

*Field notes*: Common through out the shady and moist slopes and waste lands, 500 – 2700 m.

*Specimens examined*: Gyathang to Dikchu, *N. R. Mandal*, 10428 (BSHC); Linju to Pentong, *N.R. Mandal* 1119 (BSHC).

**2. Cyanotis axillaris** ( L.) D.Don ex Sweet, Hort. Brit.430.1826; Hook. f., Fl. Brit. India 6: 388. 1892; Karthik. & al., Fl. India. Enum. Monocot. 23.1989. Noltie, Fl. Bhutan 3(1): 222. 1994. *Commelina axillaris* L., Sp. Pl. 1: 42. 1753. *Tonningia axillaris* ( L.) Kuntze, Revis.Gen. Pl. 2: 721. 1891; Karthik. & al., Fl. India. Enum. Monocot. 23.1989. *Amischophacelus axillaris* (L.) R.S. Rao & Kammathy in J. Linn. Soc. Bot. 59. 305. 1966.

Herbs, annual; stem creeping, glabrous, with spreading branches, ascending part 10-35 cm high. Leaves all cauline, linear-lanceolate, 4-8.5 x 0.2-0.9 cm, acute or acuminate at apex, base narrowed to a small petiole, glabrous, leaf sheath concealing the flowers, glabrous, margin of the sheath usually with long white hairs. Flowers blue, 3-6 in short axillary clusters of inflated leaf sheath; calyx split up to half, sepals 3, c. 7 x 1.5 mm, linear-lanceolate, enlarged in fruit; corolla slender, petals ovate, c. 1 cm long; stamens 6, filaments bluish, covered with jointed hairs, inserted at base; anthers yellow, oblong; styles filiform, glabrous. Capsules oblong, glabrous, acute, apiculate. Seeds oblong or subcylindrical, c. 2 x 1 mm, coarsely pitted, shining.

*Flowering & Fruiting* : May – September.

*Field notes*: Scattered in marshes, humid sandy places, 300-900m

*Specimens examined*: Along Teesta river bed, Rangpo, S.S.Dash 19523 (BSHC).

- 3. *Cyanotis cristata* (L.) D. Don**, Prodr. Fl. Nepal 46. 1825; Hook.f., Fl. Brit. India 6: 385. 1892; H. Hara, Fl. E. Himal. 400. 1966; Karthik. & al., Fl. India. Enum. Monocot. 26.1989; Noltie, Fl. Bhutan 3(1): 222. 1994. *Commelina cristata* L., Sp. Pl. 1: 42. 1753.

Herbs, perennial; roots fibrous; stems erect or procumbent, inconspicuously grooved. Leaves ovate-oblong or oblong-lanceolate, 3-6 x 1-1.5 cm, acute or rounded at base, acute at apex, margin densely ciliate, glabrous on upper surface, lower surface sparsely hairy with spreading hairs. Inflorescence of elongated cincinnus, solitary; peduncles recurved and exerted from a spatheaceous bract, margin densely pubescent, bracteoles overlapped, glabrous, sickle shaped. Flowers pink or pale blue; sepals linear-oblong or lanceolate, acute at apex, hairy at apex, keeled; petals oblong, blue; stamens 6, filaments with beaded hairs; styles thickened at apex. Capsules oblong, whitish pubescent at apex. Seeds pitted, boss apically present, truncate on common end, slightly ribbed.

*Flowering & Fruiting* : May – September.

*Field notes*: Common on rocky places and damp mossy ground, 200 – 2000 m.

*Specimens examined*: Tareng to Dead Khola, N.R. Mandal 11378 (BSHC); Dikchu, N.R. Mandal, 10407 (BSHC); Dikchu, R.C. Srivastava 12173 (BSHC); Machung Gumpa, N. R. Mandal & P. Singh 13414 (BSHC).

- 4. *Cyanotis fasciculata* (B. Heyne ex Roth) Schult. & Schult.** in J.J. Roemer & J.A. Schultes, Syst. Veg. 7: 1152. 1830; Hook.f., Fl. Brit. India 6: 387. 1892; Karthik. & al., Fl. India. Enum. Monocot. 26.1989; Noltie, Fl. Bhutan 3(1): 221. 1994. *Tadescantia fasciculata* B. Heyne ex Roth, Nov. Pl. Sp. 189.1821.

Herbs, perennial; stems decumbent, grooved, often rooting at nodes; roots fibrous. Leaves linear-lanceolate, 1-4 x 0.3-0.5 cm, acute at apex, base attenuate, silky arachnoid beneath; leaf sheath up to 1 cm long, membranous on dry. Inflorescence in cincinnus, axillary or terminal, subtended by a leafy involucre bract; bracteoles sickle shaped, densely silky arachnoid pubescent, 1-1.5 x 0.5-0.7 mm. Sepals oblong, 3-4.5 x 1-1.5 mm; stamens 6; anthers emarginated; filaments slightly exerted. Capsules oblong, whitish pubescent near apex. Seeds conical, boss rounded towards one end, obscurely pitted and rugose.

*Flowering & Fruiting* : July – October.

*Field notes*: Common on dry fields, waste lands 500 – 2500 m

*Specimens examined*: Namak to Dikchu, N.R. Mandal 11271 (BSHC); Bichu to Chungthang, N.R. Mandal 10068 (BSHC).

- 5. *Cyanotis vaga* (Lour.) Schult. & Schult.** in J.J. Roemer & J.A. Schultes, Syst. Veg. 7: 1153. 1830; H. Hara, E. Himal. 400. 1966; Karthik. & al., Fl. India. Enum. Monocot. 27.1989; Noltie, Fl. Bhutan 3(1): 220. 1994. *Tradescantia vaga* Lour. Fl. Cochinch. 1: 193. 1790. *Cyanotis barbata* D. Don, Prodr. Fl. Nepal 46. 1825; Hook.f., Fl. Brit. India 6: 385. 1892.

Herbs, perennial 40-70 cm high; stems decumbent, rooting at nodes; roots bulbiferous. Leaves linear lanceolate, 1.5-9 x 0.3-0.7cm, tapering gradually from base to apex, base terminates to a leaf sheath, entire, glabrous or very minutely pubescent on both sides; leaf sheath 0.5 – 1.5 cm, sparsely hairy, mouth of the

sheath densely whitish ciliate. Inflorescence in scorpioid cymes, axillary or terminal, subtended by a leaf-like spathe, bracteoles overlapped, sickle shaped, acuminate at apex, margins white hairy. Sepals fused at base, oblanceolate, acute, 4-5 x 1-1.5 mm, white hairy near apex and margin; corolla blue, tubular on lower side; lobes oblong or obovate, 6-8 mm across; stamens 6, filaments exserted from corolla, beaded with white hairs, anthers oblong, emarginate, yellow; ovary truncate at apex, hairy, styles exserted, beaded towards apex, c. 7 mm long. Capsules trilobed, truncate, hairy towards apex. Seeds 2 in each locule, rugose, truncate at both ends.

*Flowering & Fruiting* : July to November.

*Field notes*: Common on rocks, open fields and sloppy areas, 500 – 2800 m.

*Specimens examined*: Gangtok, *N.R. Mandal* 7279 (BSHC); Dikchu, *N.R. Mandal* 10428 (BSHC); Orkhey to Hilley, *P. Singh* 13963 (BSHC); Kabi, *N.R. Mandal*, 13082 (BSHC); Lachen *S.S. Dash* 19492 (BSHC).

#### 4. FLOSCOPA LOUR.

Herbs perennial; stems densely hairy on young parts. Leaves lanceolate, sheaths tubular, with a wide open mouth, mouths ciliate. Inflorescence in terminal branched thysiform racemes; branches densely hairy. Flowers minute, bracteate, pedicels hairy; sepals oblong, free; petals obovate, free; stamens 5 + 1, 2 outer stamens straight, 3 inner stamens shorter, anthers deflexed, filaments glabrous, ovary 2-celled. Capsules 2-valved, loculicidal, and shining. Seeds oblong, with radiating grooves from the central boss.

C. 20 species distributed in tropical and warmer regions (Mabberley 2008); 1 species in India including Sikkim. (Karthik.& al. 1989).

**1. *Floscopa scandens*** Lour., Fl. Cochinch. 1: 193. 1790; Hook. f., Fl. Brit. India 6: 390. 1892; H. Hara, Fl. E. Himal. 401. 1966; Karthik. & al., Fl. India. Enum. Monocot. 25.1989; Noltie, Fl. Bhutan 3(1): 225. 1994.

Herbs perennial; stems c. 50 cm high, erect or decumbent, creeping below, terete, sparsely hairy. Leaves lanceolate or elliptic, 3-9 x 1-2.5 cm, acuminate at apex, entire at margin, base cuneate, glabrous, occasionally pubescent above; leaf sheath 1.5-3 cm long, densely ciliate at mouth, mouth wide open. Inflorescence in terminal, thyrsoid branched panicles, peduncles 2-10 cm long; bracts leafy. Flowers pink-violet, minute, pedicels 2-5 mm long, densely hairy; sepals 3, oblong or oblanceolate, 3.5 x 1.5 mm, acute at apex, truncate at apex, persistent, free, densely hairy outside; petals obovate-lanceolate, 3, free; perfect stamens 5; filaments glabrous, connate below; anthers orbicular, deflexed; ovary 2 locular, styles 2-6 mm. Capsules 2 valved, crustaceous, loculicidal, oblong. Seeds ellipsoid, margin undulate, 2 x 1 mm, glabrous, grooved with radiating from a central boss.

*Flowering & Fruiting* : August – March.

*Field notes*: Common on wet grounds, 300 – 1500 m.

*Specimens examined*: Gangtok, *P.K. Hajra* 682 (BSHC), Teesta river bed near Bardang *S. S. Dash* 20931 (BSHC); Mangal *B. Krishna* 3215 (BSHC); Dikchu, *D.C.S. Raju & R. C. Srivastava* 12154 (BSHC).

#### 5. MURDANNIA ROYLE (nom cons.)

Herbs, annual or perennial; roots often fusiform, stems prostrate or decumbent. Leaves linear or lanceolate, occasionally basal rosette present. Inflorescence in terminal and axillary cymes, often in paniculate cymes; peduncles leafy or leafless; bracteoles caducous or persistent. Sepals and petals free and similar; stamens 6, outer 3-4 sterile, inner 2-3 fertile; filaments hairy, occasionally glabrous, anthers oblong. Ovary 3-locular, ovules 1-4. Capsules 3-locular. Seeds 1-4 in each locule, variously rugose, hilum linear, boss lateral to dorsal.

c. 50 species distributed in the tropical and warmer regions (Mabberley 2008); 24 species in India (Karthik.& al. 1989); 6 species in Sikkim.

- 1a. Stem leafless, roots thickened, flowers appear before or with young leaves 2. *M. edulis*
- 1b. Stem leafy; roots not thickened; flowers appears when stem is leafy 2
- 2a. Inflorescences of one flowered cymes, capsules one seeded 6. *M. vaginata*
- 2b. Inflorescences many flowered cymes, capsules more than one seed 3
- 3a. Leaves linear or linear-lanceolate, capsules 2-seeded in each locule 4. *M. nudiflora*
- 3b. Leaves oblong or ovate; seeds more than 3 in each locule 4
- 4a. Plants with horizontal rhizomes; leaves ovate-lanceolate; seeds 4 in each locule. 5. *M. spirata*
- 4b. Plants without horizontal rhizomes, leaves elliptic; seeds numerous in each locule 5
- 5a. Leaves with clasping base, seed boss symmetrically placed. 3. *M. japonica*
- 5b. Leaves without clasping base, seed boss asymmetrically placed. 1. *M. divergens*

**1. *Murdannia divergens*** (C.B. Clarke) G. Bruckn. in H.G.A. Engler Nat. Pflanzenfam. ed. 2, 15a. 173. 1930; Karthik. & al., Fl. India. Enum. Monocot. 28.1989; Noltie, Fl. Bhutan 3(1): 228. 1994. *Aneilema herbaceum* (Roxb.) Wall. ex C.B. Clarke var. *divergens* C.B. Clarke in J. Linn. Soc., Bot. 11: 448. 1870. *Aneilema divergens* (C.B. Clarke) C.B. Clarke, Commelyn. & Cyrt. Bengal. 28. 1874; Hook. f., Fl. Brit. India 6: 376. 1892.

Herbs, annual or perennial; roots tuberous; stems up to 35 cm long, erect. Leaves sessile, linear-lanceolate, 9-15 x 1-1.5 cm, acute at apex, base rounded, minutely red spotted above; leaf sheaths 1-2 cm long, whitish ciliate at margin and mouth. Inflorescence in terminal panicles, 3-8 cm long; bracts ovate, persistent; bracteoles c. 5 x 2.5 mm, clasping, membranous. Flowers pinkish; sepals linear-oblong, c. 2 x 1 mm, glabrous; petals obovate, c. 8-10 x 5-7 mm, stamens 3 perfect, unilateral, filaments 3-4 mm long, bearded with purplish hairs; anthers lobes oblong, c. 1 x 0.5 mm; styles 2-4 mm long, straight. Capsules ellipsoid, acute at both ends, 3-locular, styles persistent in fruit. Seeds 3 in each locule, yellowish, c. 1 x 0.5 mm, boss asymmetrically placed.

*Flowering & Fruiting* : June-September.

*Field notes*: Common among open bushes, hilly moist slopes, 1000 – 2000 m.

*Specimens examined*: Dikchu, N.R. Mandal 9950 (BSHC).

**2. *Murdannia edulis*** (Stokes) Faden in Taxon 29: 77.1980; Karthik. & al., Fl. India. Enum. Monocot. 28.1989. *Commelina edulis* Stokes, Bot. Mat. Med. 1:184.1812. *Aneilema scapiflorum* (Roxb.) Kostel., Allg-Med. Pharm. Fl. 1: 127. 1831; Hook.f., Fl. Brit. India 6: 637. 1892. *Commelina scapiflora* Roxb., Fl. Ind.( eds. Carey & Wall.)1: 178. 1820.

Annual herbs; roots fibrous; stems 10-25 cm high. Leaves all in basal rosette, absent during flowering period, radical leaves linear lanceolate, 10-15 x 1-1.5 cm, acuminate at apex, base rounded, minutely red-spotted on above; leaf-sheaths long whitish ciliate at margin and mouth. Inflorescence in terminal leaf less scapes; bracts large sheathing base, upper bracts amplexicaule. Flowers blue-mauve; sepals linear-ovate; petals obovate or suborbicular, 9-10 x 5-6.5 mm; perfect stamens 3; filaments beaded, staminodes 3, antheroids yellow; styles filiform. Capsules oblong-ellipsoid, mucronate at apex, 3-valved. Seeds 4 in each locule, boss asymmetrically placed.

*Flowering & Fruiting* : May – August.

*Field notes*: Scattered on grassy slopes. 600-1800m.

*Specimens examined*: Sikkim G. King s.n.[Acc.No. 487888 (CAL)].

**3. *Murdannia japonica*** (Thunb.) Faden in Taxon 26: 142. 1977; Karthik. & al., Fl. India. Enum. Monocot. 28.1989; Noltie, Fl. Bhutan 3(1): 226. 1994. *Commelina japonica* Thunb. in Trans. Linn. Soc. London 2: 332. 1794. *Aneilema lineolatum* Kunth, Enum. Pl. 4: 69. 1843; Hook. f., Fl. Brit. India 6: 376. 1892.

Herbs, perennial; roots fibrous; stem stout, c. 1m long, deeply grooved, glabrous, arising from basal rosettes. Leaves lanceolate or oblong, 8-16 x 2-3.5 cm, base clasped to the stem, entire, acuminate at apex, glabrous; leaf sheath open, 1-3cm long, pubescent along the margin. Inflorescence in axillary and terminal thyriform panicles, branches spreading, glabrous; bracts tubular. Flowers blue, pedicels c. 1cm long; sepal oblong lanceolate; 4-5 x 2.5-3mm, membranous; petals obovate, 4 x 2 mm, equalling to sepal; perfect stamens 4, filaments 2-4 mm long, white beaded; anthers ellipsoid, 1 x 1 mm; antheroids yellow, c. 0.7 x 0.8 mm, reflexed; ovary trigonous, styles persistent. Capsules ellipsoid-trigonous, mucronate at apex, loculicidal. Seeds 4 in small, papillose.

*Flowering & Fruiting* : June – September.

*Field notes*: Scattered in the wet and moist places, 1200-2000m.

*Specimens examined*: Rongli Khola, DCS Raju 4051 (BSHC).

- 4. *Murdannia nudiflora* (L.)** Brenan in Kew Bull. 7: 189. 1952; Hara, Fl. E. Himal. 401. 1966; Noltie, Fl. Bhutan 3(1): 229. 1994. *Commelina nudiflora* L., Sp. Pl. 1:41. 1753. *Aneilema nudiflorum* R.Br., Prodr. 271.1810; Hook.f., Fl. Brit. India 6: 378. 1892.

Herbs, annual; stems profusely branched near apex, decumbent, rooting at nodes, glabrous. Leaves linear or linear-lanceolate, sessile, 2-7 x 0.5-1 cm acute at apex, entire, base rounded or truncate, glabrous; leaf sheath c. 1 cm long, whitish ciliate at mouth and margin. Inflorescence in terminal or leaf-opposed paniculate cymes or capitate, 4-10-flowered; peduncles 3-7cm long, leafy or prominently marked with fallen bracteole scars. Flowers bluish or pink; sepals oblong-lanceolate, hooded, 3-5 x 1-2 mm glabrous; petals 3-4 x 1-2.5 mm; perfect stamens 2; filaments 2-3 mm long hairy with whitish hairs; staminodes bright yellow; styles c. 2 mm long. Capsules oblong, mucronate, 3-locular, each locule with 2 seeds. Seeds broadly oblong, rugose and pitted, truncate at common wall, acute on other wall, boss rounded.

*Flowering & Fruiting* : July – September.

*Field notes*: Common on shady and moist ground, 300 – 2700 m.

*Specimens examined*: Rongpo, S.S. Dash 20927 (BSHC); Gangtok, DCS Raju 1308 (BSHC); Lachen, N.R. Mandal 11073 (BSHC); Dentam, P. Singh 16394 (BSHC).

- 5. *Murdannia spirata* (L.)** G. Bruckn. in H.G.A. Engler, Nat. Pflanzenfam. ed. 2, 15a: 173. 1930; H. Hara, Fl. E. Himal. 402. 1966; Karthik. & al., Fl. India. Enum. Monocot. 30.1989; Noltie, Fl. Bhutan 3(1): 229. 1994. *Commelina spirata* L., Mant. Pl. 2: 176. 1771. *Aneilema spiratum* (L.) Sweet, Hort. Suburb. Land. 12.1808; Hook. f., Fl. Brit. India 6: 377. 1892.

Diffuse herbs; stems ascending or procumbent, pubescent along a line, much branched at base. Leaves oblong, 1.5-3.5 x 0.7-1.2 cm, acute at apex, base obtuse, rounded or cordate, upper leaves amplexicaule, entire, glabrous on both surfaces, upper surface minutely papillose, leaf sheath 0.5-1cm long, pubescent along margin and mouth. Inflorescence in terminal, branched paniculate cymes, 4-6- flowered, bracteoles cupular, persistent. Flowers violet; sepals brownish, ovate-lanceolate, 2-3 mm long; petals obovate, c. 4 x 3.5 mm; stamens 3; filaments c. 2mm long, glabrous or beaded. Capsules oblong, acutely trigonous, mucronate or shortly beaked at apex. Seeds 4, in a single row in each locule, cuboid, smooth, minutely papillose.

*Flowering & Fruiting* : July-September.

*Field notes*: Common in river banks, rice fields and moist areas.

*Specimens examined*: Burtuk, S.K. Rai 16084 (BSHC); Pentong to Sakyong, N.R. Mandal 11067 (BSHC); Bay to Tendong, N.R. Mandal 10591 (BSHC).

- 6. *Murdannia vaginata* (L.)** G. Bruckn. in H.G.A. Engler Nat. Pflanzenfam. ed. 2, 15a: 173. 1930; Karthik. & al., Fl. India. Enum. Monocot. 30.1989. *Commelina vaginata* L., Mant. Pl. 2: 177. 1771. *Aneilema vaginatum* (L.) Wall., Num. List 5212.1831; Hook. f., Fl. Brit. India 6: 381. 1892.





**Fig. 2.** A. *Pollia submubellata*. B. *Amischotolype hookeri*. C. *Amischotolype glabrata*. D. *Streptolirion volubile*. E. *Floscopa scandens*.



Herbs, perennial; roots fibrous; stem decumbent, 10-50 cm long, rooting at lower nodes. Leaves linear or linear lanceolate, 5-10 x 0.7-1 cm, acuminate at apex, glabrous; leaf sheath open. Inflorescence in 1-3 flowered fascicled cymes. Flowers purple, shortly pedicellate, pedicels jointed in the middle; sepals linear-oblong, blue, ovate or oblong; stamens 2, staminodes 4. Capsules 3-locular, 1 seed in each locule.

*Flowering & Fruiting* : July – October.

*Field notes*: Common in wet grounds, Gangtok, 515 – 1800 m.

*Specimens examined*: Sichey-Gangtok, *N.R. Mandal* 11138 (BSHC).

## 6. POLLIA THUNB.

Herbs, perennial; rhizomes horizontal, stem ascending. Leaves lanceolate or elliptic-lanceolate. Inflorescence in terminal paniculate cymes. Sepals 3, free; petals 3, free, obovate, persistent. Stamens 6 or 3, all equal; filaments glabrous. Ovary 3-celled, each cell with 2 rows of ovules. Fruits globose or ovoid, indehiscent. Seeds vertically compressed, hilum punctate, boss centrally placed.

*c.* 17 species distributed in the old World tropics (Mabberley 2008); 5 species in India Karthik. & al. 1989); 2 species in Sikkim.

- 1a. Stamens all fertile; inflorescence with peduncles, sepals pubescent on outer side *1. P. hassakarlui*
- 1b. Stamens 6, 3 fertile, 3 sterile; inflorescence without peduncle; sepals glabrous outside. *2. P. subumbellata*

**1. Pollia hasskari** R. S. Rao in Notes, Roy. Bot. Gard. Edinburgh 25: 188. 1964; Karthik. & al., Fl. India. Enum. Monocot. 30.1989; Noltie, Fl. Bhutan 3(1): 232. 1994. *Pollia aclisia* Hassk. Commelin. Ind. 55.1870, *non* Hassk.1852; Hook. f, Fl. Brit. India 6: 367. 1892.

Perennial herbs; stems 50-90 cm high, terete. Leaves coriaceous, lanceolate or oblanceolate, 11-32 x 3-6 cm, finely acuminate at apex, entire at margin, attenuate at base and gradually narrowed to a broad petiole, glabrous on both sides; leaf sheaths 3-5 cm long; persistent in older parts. Inflorescence pyramidal, peduncles stout, 4-9 cm long, subtended by a small leaf like bract. Flowers white; pedicels *c.* 5 mm long, pedicels and peduncles densely clothed with hooked hairs. sepals 3, concave, orbicular, 4-5 mm across, hairy on outside, membranous; petals 3; ovary globose, 1-2 mm long, glabrous; styles 3mm long. Fruits subglobose capsules, *c.* 6 mm across blue-black, shining. Seeds brown, 5-8 in each locule, flattened and angled.

*Flowering & Fruiting* : June – September

*Field notes*: Rarely found in moist and shaded places, between 500-1800 m.

*Specimens examined*: Dikchu-Abdora, *N.R. Mandal* 11230 (BSHC); Lingdhen, *B. Mitra* 6891 (BSHC).

**2. Pollia subumbellata** C.B. Clarke in J. Linn.Soc., Bot. 11: 451. 1870; Hook. f., Fl. Brit. India 6: 368. 1892; Karthik. & al., Fl. India. Enum. Monocot. 30.1989; Noltie, Fl. Bhutan 3(1): 233. 1994.

Perennial herbs; stems 20-40 cm high, ascending, rooting at nodes. Leaves elliptic, lanceolate, 6-13 x 2-4 cm, caudate-acuminate at apex, entire at margin, narrowed at base, scaberulous on both surfaces; petioles *c.* 2cm long; sheathing at base, sheaths 2-3 cm long, minutely pubescent. Inflorescence in sessile, subumbellate panicles, branches deflexed. Flowers white; pedicels 3 mm long, bracts small, subulate, persistent, amplexicaule at base; sepals 3, elliptic-ovate, *c.* 5 x 3 mm, glabrous; petals 3; stamens 6, 3 fertile and 3 sterile; ovary globose, glabrous. Fruits subglobose. Seeds trapezoids; dorsally much flattened.

*Flowering & Fruiting* : July – October.

*Field notes*: Commonly found in moist areas, 300 – 1800m.

*Specimens examined*: Dikchu Bazar, *N.R. Mandal* 11706 (BSHC); Dikchu dam site, *N.R. Mandal* 11758 (BSHC).

## 7. RHOPALEPHORA HASSK.

Erect herbs. Leaves lanceolate, acuminate, narrowed at base, densely hispid on margin. Inflorescence in branched panicles; bracts funnel shaped, acuminate, persistent. Petals free, stamens 2-3 perfect, filaments glabrous. Capsules globose hairy, sepals reflexed in fruit. Seeds 1 per locule.

3-4 species distributed in Madagascar and India to Vietnam (Mabberley 2008); 1 species in India including Sikkim (Karthik. & al. 1989).

**1. Rhopalephora scaberrima** (Blume) Fader in Phytologia 37:480.1977; Karthik. & al., Fl. India Enum. Monocot. 31.1989. *Commelina scaberrima* Blume, Enum. Pl. Jav. 1: 4. 1827. *Dictyospermum scaberrimum* (Blume) C.V.Mortan ex Panigrahi in Phytologia 29: 338. 1975 (1974). *Aneilema scaberrimum* (Blume) Kunth, Enum. Pl. 4: 69. 1843; Hook.f., Fl. Brit. India 6: 382. 1892; H. Hara in Fl. E. Himal. 399. 1966.

Herbs, perennial; stems erect, c. 1m tall. Leaves 3-12 x 2-3.5 cm, lanceolate, acuminate at apex entire, margin ciliate, narrowly attenuate at base to a short petiole, sparsely pubescent above, more along margin; petioles c. 2cm long; leaf sheath 2-3.5 cm, hairy, mouth long ciliate. Inflorescences in terminal, thyrisiform branched cymes, peduncles hairy, deflexed in older. Flowers bluish or purple; pedicels 1-2cm long, glabrous, bracts funnel shaped with oblique mouth; sepals 3, ovate, c. 3 x 1 mm, glabrous, margin scaberulous; petals 3, c. 5 x 2 mm; stamens 6, outer stamens 3, perfect; filaments c. 4mm long, anther lobes yellow; antheroids bright yellow; ovary globose, single, c. 4 mm. Capsules oblong, densely hooked hairy. Seeds 1 per locule, oblong-ellipsoid, boss asymmetrically placed, coarsely rugose.

*Flowering & Fruiting* : August – October.

*Field notes*: Common throughout the marshy places. 700-1950m.

*Specimens examined*: Sichey, *B. Krishna* 1698 (BSHC); Deorali, *N.R. Mandal* 13724 (BSHC); Dikchu, *N.R. Mandal* 9963, 9964 (BSHC); Bijan Bari, *N.R. Mandal* 11719 (BSHC); Namchi, *R.C.Srivastava* 11497 (BSHC).

## 8. STREPTOLIRION EDGEW.

Twining herbs; stem grooved. Leaves ovate-cordate, caudate-acuminate at apex, margin densely ciliate, deeply cordate at base. Inflorescence in axillary or terminal racemes. Flowers usually bisexual, when unisexual then only male; sepals ovate-oblong, petals linear, free; stamens 6; anthers yellow; filaments beaded with jointed hairs, hairs yellow; ovary trigonous. Capsules 3-valved, beaked.

1 species distributed in E. Himalaya to Korea and SE Asia (Mabberley 2008).

**1. Streptolirion volubile** Edgew. In Proc. Linn. Soc., London 1: 245. 1845. Hook. f., Fl. Brit. India 6: 389. 1892; H. Hara, Fl. E. Himal. 402. 1966; Karthik. & al., Fl. India Enum. Monocot. 31.1989; Noltie, Fl. Bhutan 3(1): 218. 1994.

1a. Stems and leaves glabrous.

8.1 subsp. *volubile*

1b. Stem and leaves densely pubescent with brown hairs.

8.2. subsp. *khaisanum*

### 8.1. subsp. *volubile*

Twining herbs; stems deeply grooved. Leaves ovate-cordate or cordate-orbicular, upper leaves 6-9.5 x 4.5-7 cm, lower leaves 10-13 x 8.5-11 cm, long acuminate at apex, densely ciliate at margin, base deeply cordate, upper surface glabrous, reticulate venation prominent on beneath; petioles 3-10 cm long; sheaths short, 0.5-1 cm long, glabrous, mouth ciliate, oblique. Inflorescence borne at each node, in thyriform panicles; peduncles 4-15 cm long, subtended by a leafy bract. Flowers bisexual or unisexual, when unisexual only with male flowers, white; sepals 3, free, ovate-oblong, c. 3 x 1.5 cm; petals 3, linear-lanceolate, free, c. 4 x

0.7 mm, stamens 6, filaments 0.7-1 mm long, beaded with jointed hairs; anthers dumb-bell shaped; filaments connate below; ovary 3-locular, gradually tapers to a style, style c. 0.5 mm long. Capsules oblong-trigonal, beaded, loculicidal.

*Flowering & Fruiting* : July – October.

*Field notes*: Scattered in moist areas, 1000-3000 m.

*Specimens examined*: Rabongla, A.K. Verma 6532 (BSHC); Gangtok, P.K. Hajra 559 (BSHC); Rate-Chu, D.G. Long & al., 17767 (BSHC).

**8.2.** subsp. **khasianum** (C.B. Clarke) D. Y. Hong, in Acta Phytotax. Sin. 12:463.1974. Karthik. & al., Fl. India. Enum. Monocot. 31.1989. *Streptolirion volubile* var. *khasianum* C.B. Clarke in A. DC & C. DC. Monogr. Phan. 3: 261. 1881.

*Flowering & Fruiting* : July – September.

*Field notes*: Rarely found in the tropical and subtropical broad leaved forests. 900 – 1800 m.

*Specimens examined*: Damthang, R. Gopalan 97609 (BSHC).

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## सिक्किम के कोमेलिनेसी कुल पर व्यवस्थित अध्ययन

एस.एस. दास

### सार संक्षेप

सिक्किम में कोमेलिनेसी कुल में शामिल 8 वंश और 25 प्रजातियों के विस्तृत वर्गीकरण के साथ मौजूद पेपर संबंधित हैं। वर्ण के आधार पर वंश और प्रजातियों के लिए एक कुंजी भी आसान पहचान के लिए दी गई है। वर्तमान पेपर में *स्ट्रेप्लोरियम वोल्यूबल* सबस्पी. *खासियनम* (सी.बी. क्लार्क) डी वाई हांग की सिक्किम से पहली बार सूचना दी है।

## CONTRIBUTION TO THE BAMBOOS OF EASTERN INDIA

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### ABSTRACT

Morphological description is completed for *Bambusa jaintiana* and *B. pseudopallida*. Floral morphology is provided for *Yushania hirsuta* for the first time and notes on few important characters of climbing bamboo *Melocalamus indicus* are given.

**Keywords :** Bamboo, *Bambusa jaintiana*, *B. pseudopallida*, *Melocalamus indicus*, *Yushania hirsuta* description, first flowering.

### INTRODUCTION

Bamboos are one of the most difficult groups of plants to identify. These are monocarpic with very uncertain flowering records and most of the old herbarium specimens are representing only a part of their life cycles as many are having either only vegetative or only flowering materials. Like wise the species described are often based on part information only. Moreover morphological variations, within populations of a species and overlapping characters between different species, add to the woes of taxonomists for their correct identification. Quite often the same species has been redescribed again due to lack of complete description.

J.S.Gamble (1896) described 115 species from the then Indian subcontinent, as per recent estimates there are c. 140 species present in India of which quite a substantial number are less known and based on meagre descriptions and insufficient materials. Four such species of eastern India are discussed here.

### DISCUSSION

*Bambusa jaintiana* R.B.Majumdar was described in 1989 from Meghalaya, India, with very little diagnostic features which distinguish this species from *B. tulda* Roxb. in having glabrous culm-sheaths, smaller auricles and shrubby habit.

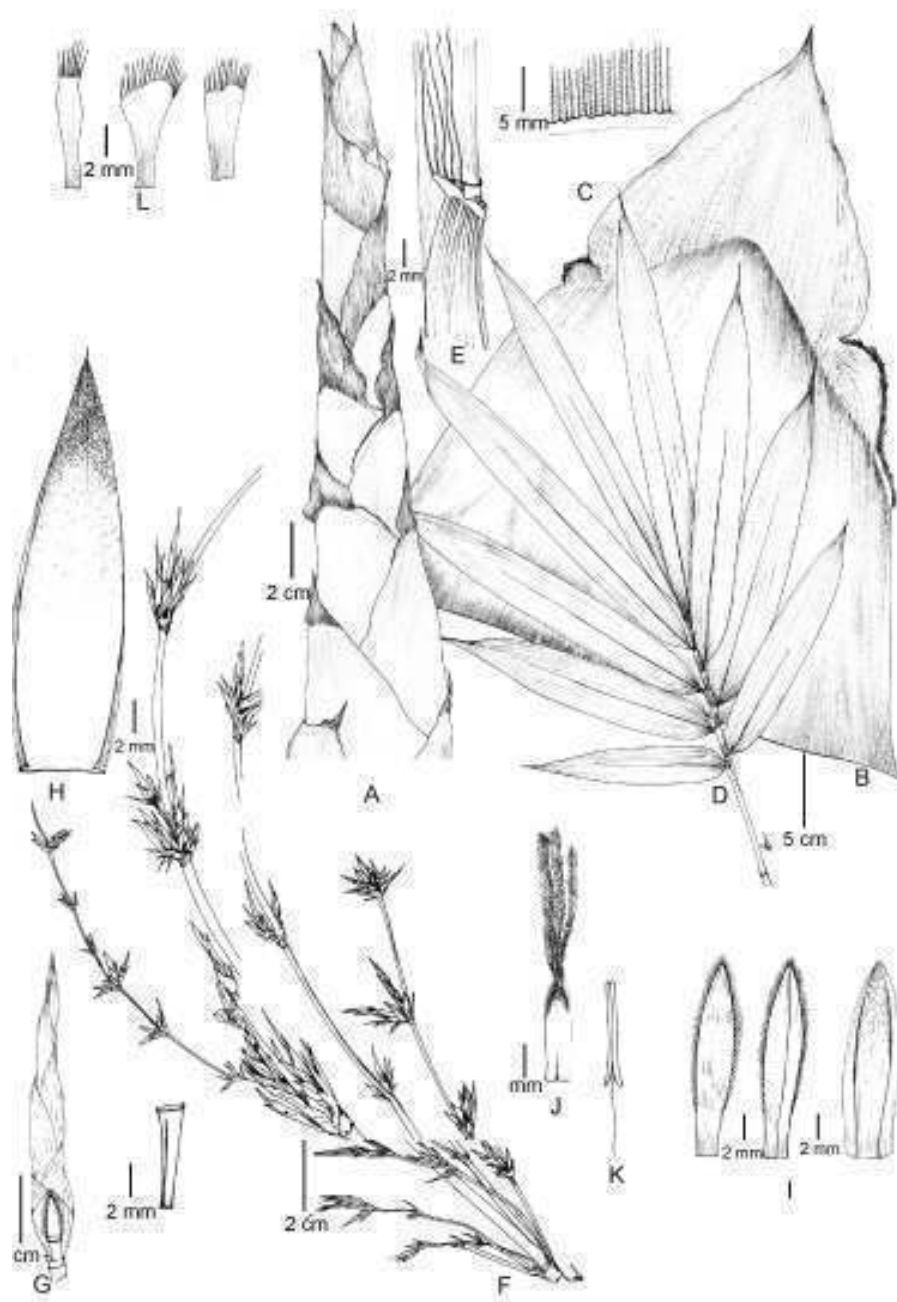
Subsequently *B. alamii* Stapleton was described in 1994 from Nepal differentiated from *B. eutuldoides* McClure. Though the holotype of *B. jaintiana* bears culm-sheaths, leaves and inflorescence, the species was minimally diagnosed, the same species was redescribed as *B. alamii* by Stapleton (1994). However, later on Stapleton (2000) mentioned that *B. alamii* has been considered as a synonym of *B. jaintiana* by Alam & Hasan (1994). Most of the workers (Tiwari 1992, Seethalakshmi & Kumar 1998) have given only a brief description of this species. Here the full description and illustration is provided for this commercially important species which is widely distributed in the North eastern states including Assam, Meghalaya, Manipur, West Bengal and extending to Bangladesh, Nepal and Bhutan. This species was found in sporadic flowering from Meghalaya.

***Bambusa jaintiana*** R.B.Majumdar in Karthik. & al., Fl. Ind. Enum. Mono. 275. 1989; D.N.Tiwari, Monogr. Bamboo 39. 1992; Seethalakshmi & Kumar, Bamboos India 53. 1998. Type: Shillong, G. K. Deka 31765 (holo. CAL; iso. ASSAM). '*Bambusa alamii* Stapleton, Edinburgh J. Bot. 51(1): 10. 1994.

(Fig. 1).

*Vern.*: 'U-shken' (Kh.).

Shrubby erect bamboo in loose clump. Rhizome pachymorph. Culms 8-10 m tall, 2-5 cm in diameter, green, becoming orange green with age, young white powdery; nodes even; internodes 45-52 cm long, terete, thin walled (5-6 mm) smooth, glabrous; bud onion shaped; branches starts from above, occurs on all nodes, in triplets with 3 main dominating, subequal and subsequent thinner ones, horizontal. Culm-sheaths deciduous triangular, shorter than internodes, yellowish, thickish, crustaceous; sheath proper 14-23 cm long, 18-25 cm



**Fig. 1.** *Bambusa jaintiana* R.B.Majumdar: A. young shoot; B. culm-sheath; C. imperfect blade base (inner surface); D. leafy-twig; E. leaf-sheath; F. inflorescence; G. spikelet; H. lemma; I. palea; J. pistil; K. stamen; L. lodicules.

broad at base, gradually attaining into a 11-12 cm wide triangularly convex top, glabrous on outer surface, smooth and shining on inner surface, smooth at margins; imperfect blade persistent (late deciduous), erect, shorter than sheath proper, 5-20 cm long, 8-13 cm broad, triangular, cuspidate, rounded at base, continuing into unequal auricles and terminating into incurved pointed apex, striate, glabrous except minutely pubescent on inner surface, margins smooth except very short ciliate below; ligule 1-2 mm tall, crenate, ciliate at mouth; auricles not similar, smaller rounded and somewhat erect, another elongated 4-5 times of shorter one, decurrent downwards, having c. 1 cm long straight deciduous bristles. Leaves 8-9 per twig; leaf-blades lanceolate, (9-) 15-30 cm long, (1.3-) 2-3.3 cm broad, lower rounded at base, upper unequally attenuate, gradually and acuminate terminating into incurved, needle like, scabrous, 5-8 mm long apex, glabrous on adaxial surface except scabrid nerves along one margin and minute hairs along midrib in young stage, glaucous-sparsely hairy on abaxial surface; midrib thick, raised, yellowish, sometimes with sparse hair near base otherwise

glabrous, secondary veins 8-12 pairs, tertiary (6-)7, very faint cross bars may be seen; one margin fine serrated; pseudopetiole 1-2 mm long; leaf-sheath lowest 4-5 cm long, striate, glabrous, keeled, smooth, ending into shining rounded, smooth callus, margins smooth; ligule c. 1 mm tall, unevenly truncate, serrated, ciliate at mouth, glabrous underneath imperfect blade; auricles roundedly elongated, with 8-10, c. 1 cm long, straight, deciduous bristles. Inflorescence branched leafless panicle, branchlets spicate with clusters of spikelets sometimes in axil of bract; rachis rounded, glabrous. Spikelets cylindrical, 1-5 cm long, 4-7 flowered, with 2-3 gemmiparous glumes and terminal 2-3 convolute imperfect flowers; rachilla 6-7 mm long, flattened, clavate, glabrous; empty glume 1, ovate acute, glabrous, faintly multi-nerved; lemma 1.5-2.5 cm long, ovate-acute, fine hairy near apex on inner surface, faintly multinerved, transversely veined on inner surface, margins smooth; palea spathulate, shorter than lemma, 2-keeled, ciliate at keels, 7-nerved in between keels, 3-5 nerved on either side; faintly transverse veined and minutely hairy on inner surface, margins smooth; lodicules 3, variable, 1-1.2 cm long, linear or sometimes one obliquely truncate above, long white fimbriate above, thick, much dark below; stamens 6, 3-5 mm long, exserted, emarginate or apiculate at tip; ovary c. 2 mm, oblong, narrow and long hairy at apex; style short, soon dividing into 3, 4-5 mm long, feathery stigmas.

*Flowering:* Periodic. Flowering reports from Meghalaya are in 1941 by G.K. Deka from Khasi hills and in 2005 during present work from Garo hills.

*New Shoot:* June – August.

*Uses:* Chiefly used for handicrafts, basket, mats and other general purposes.

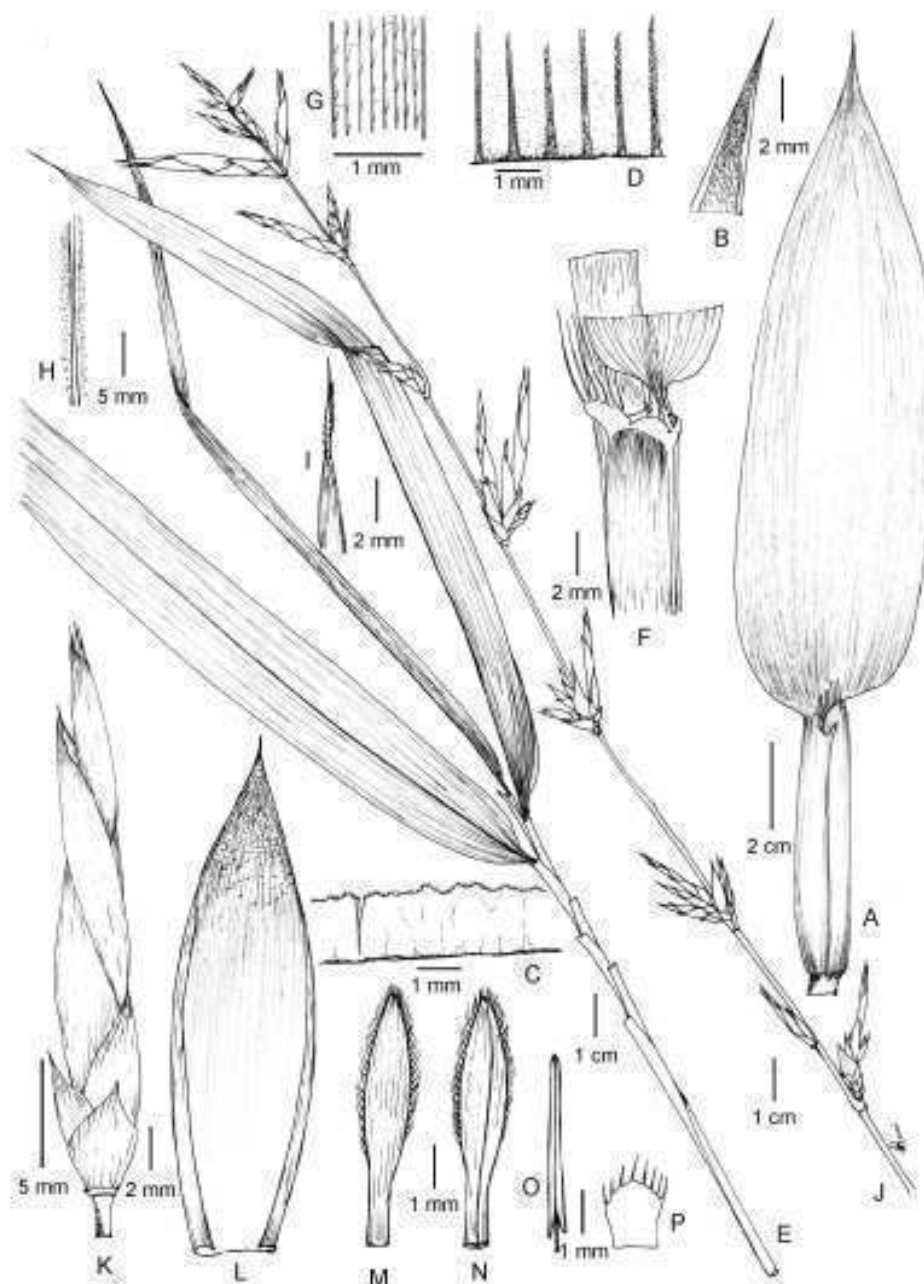
*Distribution:* INDIA: Assam, Manipur, Meghalaya, West Bengal.

BANGLADESH, BHUTAN, MYANMAR (Tiwarei, 1992; Stapleton, 2000).

*Bambusa pseudopallida* R.B.Majumdar was described from Meghalaya and was differentiated from *B. pallida* Munro in being shrubby, having longer culm-sheath blade and pointed auricles: one auricle projecting upward and the other downward. Though the holotype is a collection made from Umtapoh on Dawki – Jarain Road, this species has not further been collected and the only representative of this less known plant is its type which contains the culm-sheath, leaves and the flowering materials. Repeated tours were taken to Dawki-Jarain area and Barapani to relocate this species, but it could not be collected again and is known from type material only. U. Shukla in Grasses of N.E. India (1996) has not mentioned the species. So far the description of this species available in the literature is meager and insufficient. Based on the type materials available in CAL and ASSAM a complete description along with line drawing is provided to facilitate its identification and recollection.

***Bambusa pseudopallida*** R.B.Majumdar in Karthik. & al., Fl. Ind. Enum. Mono. 275. 1989; D.N.Tiwarei, Monogr. Bamboo 48. 1992; Seethalakshmi & Kumar, Bamboos India 74. 1998. [Type: Umtapoh on Dawki – Jarain Road, N. P. Balakrishnan 42700 (holo. CAL; iso. ASSAM); Paratype: Barapani, U. N. Kanjilal 6108 (CAL, ASSAM). (Fig. 2)]

Shrubby to moderate sized clump forming bamboo. Culms 10-15 m tall, 1.5-3 cm in diameter; node even; internodes terete, glabrous, smooth. Culm-sheaths younger rolled, somewhat thin but crustaceous, glabrous, smooth; imperfect blade longer than sheath proper, broad leaf like, minute hairy on inner surface near acute apex; auricles pointed, one projecting upward and the other downward, fringed with erect bristles. Leaves 4-5 per twig; leaf-blades lanceolate, 5-15 cm long, 1-2 cm broad, unequally rounded at base, terminating acuminate into c. 1 cm long twisted, incurved, scabrous apex; glabrous on adaxial surface except scabrid nerve along one margin, glaucous and white hairy on abaxial surface; midrib thin, yellowish, glabrous, secondary 8-9 pairs, tertiary (5-) 7, very faint pellucid dots like cross bars observed, one margin serrated; pseudopetiole short, c. 1 mm long; leaf-sheath lowest 6-9 cm long, striated, glabrous, ending into rounded, smooth, shining callus, margins smooth; ligule c. 1 mm tall, truncate, slightly oblique; auricles roundedly broad, c. 2 mm, somewhat pointed, having 5-6 straight c. 5 mm long bristles. Inflorescence spicate branches with clusters of few pseudospikelets; rachis rounded, glabrous, smooth. Spikelets yellowish, cylindrical, acute, 2-4 cm long, 6-7 flowered with 1-3 gemmiparous glumes and terminal convolute immature flower, glabrous smooth; empty glumes 2-3, 5-10 mm long, ovate, acute, glabrous, smooth, margins smooth; lemma 2-2.5 cm long, ovate, acute, glabrous, smooth on outer surface as well on inner surface except few minute hairs at apex, faintly multinerved, shortly cross-veined on inner surface, margins smooth; palea shorter than lemma, spathulate,



**Fig. 2.** *Bambusa pseudopallida* R.B.Majumdar: A. young rolled culm-sheath; B. imperfect blade apex; C. culm-sheath ligule; D. imperfect blade base (inner surface); E. leafy twig; F. leaf sheath; G. leaf abaxial surface; H. midrib; I. leaf apex; J. inflorescence; K. pseudo spikelet; L. lemma; M & N. palea; O. stamen; P. lodicules.

2-keeled, 7-nerved in between keels, ciliate at keels, hairy on inner surface; stamens 6, 8-10 mm long, blunt or somewhat acute at apex; lodicules immature c. 1 mm, rest not seen.

*Flowering* : Sporadic. Flowering recorded in 1965 from Khasi hills, Meghalaya.

*New Shoot* : June – August.

*Distribution* : INDIA: Assam, Meghalaya.

*Yushania hirsuta* (Munro) R.B.Majumdar was described in 1868 under genus *Arundinaria* by Munro. Since then this thin, small bamboo is known in vegetative form only. In 2004 (P.K. 34620) the species was collected in flowering from the Elephant water falls, Upper Shillong area. Interestingly the smaller culms coming up after a thorough clearing were found flowering. The first flowering report with the description and





**Plate 1.** *Melocalamus indicus* R.B. Majumdar **A & B.** Habit with young shoots and drooping branches **C.** Nodal bud **D.** Culm internode **E.** Culm sheath **F.** Leaf sheath **G.** Leaf apex **H.** nodal branching

illustration is presented here. On account of its sympodial rhizomes with long necks, branching patterns etc. it was placed under *Yushania* by R.B.Majumdar (1989). Recent discovery of flowering materials also support its placement under the genus *Yushania*.

***Yushania hirsuta*** (Munro) R.B.Majumdar in Karthik. & al., Fl. Ind. Enum. Mono. 282. 1989; Stapleton, Fl. Bhutan 3(2): 503. 2000. *Arundinaria hirsuta* Munro in Trans. Linn. Soc. London 26(1): 30. 1868; Gamble in Ann. Roy. Bot. Gard. Calcutta 7: 22, t. 20. 1896; Brandis, Indian trees 667. 1906; N.L.Bor, Fl. Assam 45. 1940; D.N.Tiwari, Monogr. Bamboo 23. 1992; U.Shukla, Grass. N.E. India 170. 1996. *Sinarundinaria hirsuta* (Munro) C.S.Chao & Renvoize in Kew Bull. 44: 355. 1989; S.Maulik, Grass. & Bamb. India 1: 16. 1997; Seethalakshmi & Kumar, Bamboos India 273. 1998. Type: Khasi Hills, 5600 ft, Nov. 1835, *Griffith* 6726 (lecto K). Lectotype designated by Stapleton (1997). (Fig. 3)

*Vern.*: ‘U-stoh’, ‘Dait-si-sai’, ‘U-stewiong’ (Kh.).

Small shrubby, erect bamboo with somewhat distant thin culms in loose clump. Rhizome pachymorph. Culms 1-3 m tall, c. 5 mm in diameter, greyish green; nodes raised with a ring of sheath scar; internodes terete, up to 40 cm long, thick walled, strigose hirsute first, afterwards scabrid; branches from upper nodes, intravaginal, in threes, just above the nodal line. Culm-sheaths deciduous, linear, smaller than internodes, thin, striate, crustaceous, brown; sheath proper 8-10 cm long, c. 2 cm broad, roundedly truncate into c. 5 mm top, hirsute on outer surface, smooth and shining on inner surface, margins ciliate; imperfect blade linear, 2-2.5 cm long, reflexed, margins incurved, apex acute; ligule narrow, entire; auricles rounded, reflexed, projecting outwards, fringed with c. 1 cm long, stiff bristles. Leaves 4-5 per twig; leaf-blades oblong-lanceolate, green, 7.5-15 cm long, 1.2-2 cm broad, basal leaf with equally rounded base, apical unequally rounded-attenuate, gradually terminating into a 5-7 mm long, twisted, pointed apex, glabrous on adaxial surface except minute cilia near base along midrib, abaxial surface hairy with white ascending hairs, margins serrate; midrib pale, shining, secondary veins 5-6 pairs, tertiary 8, transverse veinlets numerous, prominent; pseudopetiole 2-3 mm long; leaf-sheath lowest 5-7 cm long, striate, hairy (fine white hairy) terminating into a narrow ciliate callus, margins densely ciliate; ligule c. 2 mm tall, projecting above the auricle's height, dark, pubescent; auricles rounded, reflexed, fringed with 5-8 mm long hairy bristles. Inflorescence a terminal panicle on leafy branches; rachis angular (triangular type), striate smooth, glabrous on most of the part, often fine white hairy below. Spikelets distant, purplish, on 0.6-2 cm long pedicels, 3-spikelets originating at the first node of rachis, then 2 and finally single spikelets towards apex, lower spikelets 1-1.2 cm long, reaching up to 2.2 cm at apex, 4-7 flowered with terminal imperfect flower; rachilla 4-5 mm, towards terminal floret shorter, c. 2 mm, flattened, white hairy at apex, glabrous below; empty glumes 2, lower c. 4 and upper c. 5 mm long, ovate-acute, upper keeled, scabrously ciliate at keel above, fine ciliate at apical margins, faintly 5-7 nerved; lemma 8-9 mm long, 3-4 mm broad, ovate-acuminate, keeled, mucronate, minute hairy above on outer surface, sparsely minute hairy near apex on inner surface, short ciliate at apical margins, faintly 9-nerved; palea 6-7 mm long, oblong-lanceolate, shorter than lemma, 2-keeled, ciliate at keels, bifid and bimucronate at apex, faintly 2-nerved, minutely hairy above between keels and on either side; lodicules 3, c. 1.5 mm, ovate-acute, long fimbriate along margin, hyaline; stamens 3, c. 2 mm long, sagittate, blunt at apex; ovary c. 5 mm, ovate glabrous, with two soon dividing, short, hairy, c. 1.5 mm long stigmas.

**Flowering:** Reported by P. Kumari in 2004 from Shillong for the first time.

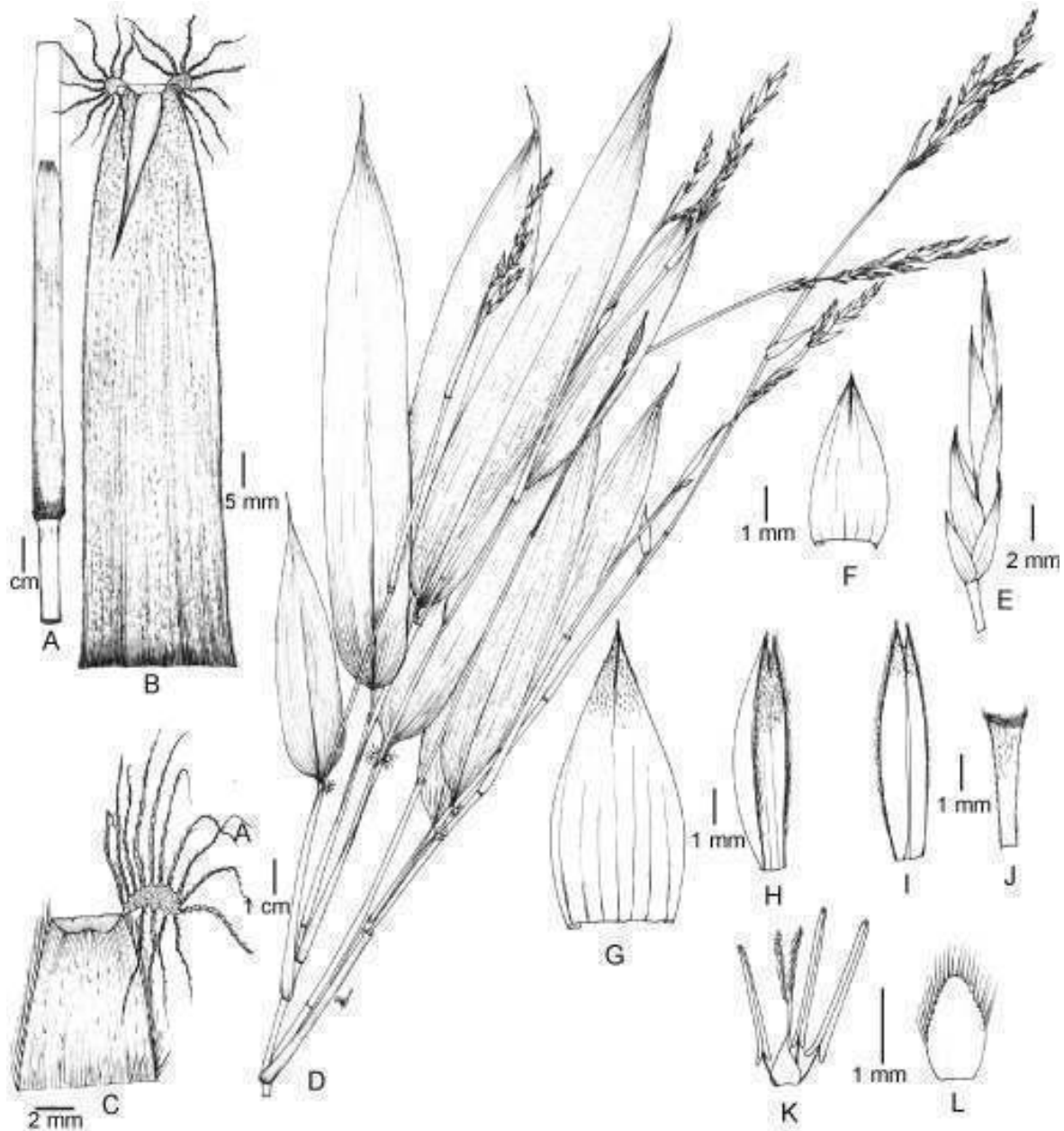
**New Shoot:** March – April.

**Distribution :** INDIA: Arunachal Pradesh, Meghalaya, Naga hills, Sikkim, West Bengal.

BHUTAN. (Gamble, 1896; Tiwari, 1992; Stapleton, 2000).

**Uses :** For roofing, fencing, making arrows popularly called ‘Rishaw’ used in ‘Arrow Shooting Game’ and as pony fodder. It is used to make the local products used by tribals as ‘smuk’, ‘sping’, ‘shna dab’, ‘pynpur khnam’, etc.

*Melocalamus indicus* R.B.Majumdar a scandent bamboo described from Cachar, Assam has recently been collected from Manipur (P.K. 38550) which reveals that the culm is thick walled and the culm-sheath ligule is long and concavely oblique. The leaf twigs mounted on the type sheet is having shaggy apex which is not evidenced in the fresh collection. Moreover there is no information about the leaf and leaf-sheaths characters. Thus here a brief description of the species is provided for its correct identification.



**Fig. 3.** *Yushania hirsuta* (Munro) R.B. Majumdar: A. culm portion; B. culm-sheath; C. culm-sheath auricle; D. inflorescence; E. spikelet; F. glume; G. lemma; H & I. palea; J. rachilla; K. pistil & stamen; L. lodicules.

**Melocalamus indicus** R.B. Majumdar, Bull. Bot. Surv. India 25: 236. 1985; *Dinochloa indica* (R.B. Majumdar) Bennet, Van Vigyan 27 (2): 121. 1989. Type: Cachar: Bhuvan Hill, *Majumdar 73083*-vegetative (CAL).

(Plate 1)

Vern.: 'Umu, Daral, Sairi' (Mani.).

Arborescent, evergreen climbing bamboo in somewhat loose clumps. Rhizome pachymorph. Culms 1-2 cm in diameter, grayish-green, arching over tall trees and then hanging downwards with tufts of green leaves at the branch tips; nodes swollen, girdled, with a white-pale, velvety band below; internodes terete, thick walled, minute silvery pubescent when young, afterwards glabrous; bud ovate; branches many, often supporting a solitary large bud or a dominating branch as thick as the main-culm. Culm-sheaths deciduous,

shorter than internodes, yellowish-brown; sheath proper 25-30 cm long, convolute, 3-4 cm broad at rounded top with a deep concave sinus, hard, crustaceous, covered with scanty patches of very deciduous silvery hairs on outer surface, smooth and shining on inner surface, margins smooth; imperfect blade deciduous, leafy, reflexed, glabrous on both surfaces; ligule c. 2.5 cm long at one side and c. 1 cm at another, oblique with concavely cut apex, glabrous; auricles obscure. Leaves 8-9 per twig; leaf-blades broadly lanceolate, 12-32 cm long, 2.5-4.5 cm broad, roundedly attenuate at base, attaining acuminate into c. 5 mm long, twisted, scabrous apex, glabrous on both surfaces; secondary veins 8-9 pairs, tertiary 7-9, margins smooth except few scabrid nerves along one side on adaxial surface; pseudopetiole 6-7 mm long; leaf-sheaths thin keeled, with scanty appressed hairs otherwise glabrous, smooth, ending above in a narrow thin callus, smooth at margins except few very deciduous cilia near apex; ligule c. 5 mm long at one side, obliquely tapering to meet the leaf-sheath margin on another side, glabrous, dark; auricles obscure. Inflorescence panicle with globular clusters of spikelets on the nodes of flexuous branches. Spikelets 2-fl., lower floret sterile and the upper hermaphrodite but without rachilla extension.

New Shoot: May – June.

*Distribution* : INDIA: Assam, Manipur.

*Uses* : Culms used for basket making and in handicraft industries.

#### ACKNOWLEDGEMENTS

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### पूर्वी भारत के बांस के लिए योगदान

पुष्पा कुमारी और पी. सिंह

#### सार संक्षेप

बैबुसा जैतियाना और बैबुसा सूडोपेलिडा के लिए रूपात्मक वर्णन पूरा हो गया है। युशानिया हिरसुता में पुष्प मोरफोलोजी की पहली बार सूचना दी गई है और मलोकैलमस इंडिकस के कुछ महत्वपूर्ण चरित्र पर नोट्स प्रस्तुत किए गए हैं।



## A PRELIMINARY SURVEY OF HEPATICAE OF LITTLE ANDAMAN ISLAND

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The Little Andaman Island lies a little towards the south of the Great Andaman group (North, Middle and South Andaman) from which it is separated by the Duncan Passage and covers an area of 739 sq. km. It is separated from the Nicobars by the 10° (Ten Degree) Channel. The climate is warm and humid tropical with the temperature ranging between 20°–32° C. The island receives rainfall twice a year, between May – September from the Southwest monsoon and October – December from the Northeast monsoon, resulting in an average annual rainfall of 3000–3500 mm. The mean relative humidity is between 82 – 85% throughout the year (Banerjee & Guha Roy, 2002).

During a recent collection of liverworts from Little Andaman Island, an area which has not so far been investigated for its bryoflora, 12 species were collected belonging to family Lejeuneaceae (11 species) and Marchantiaceae (01) species. This includes *Cololejeunea gottschei* (Steph.) Mizut., *Lejeunea anisophylla* Mont. and *Marchantia linearis* Lehm. & Lindenb. as new records for the bryoflora of Andaman & Nicobar Islands.

All the specimens cited in the text have been deposited in the Cryptogamic section of the Central National Herbarium, Botanical Survey of India, Howrah (CAL).

### ENUMERATION

#### LEJEUNEACEAE

1. **Acrolejeunea fertilis** (Reinw., Blume & Nees) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 128. 1893; Gradst. in Bryophyt. Biblioth. 4: 85. 1975. *Jungermannia fertilis* Reinw., Blume & Nees in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 211. 1824.

*Specimen examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, South Hut Bay, c.5 m, 25.05.2008, G.K. Upadhyay 47765.

*Distribution:* India [Andaman & Nicobar Islands (Andaman, Nicobar)], Sri Lanka, Myanmar, Indonesia, Malaysia, Thailand, Philippines, Vietnam, Moluccas, New Guinea (Gradstein, 1975; Tan & Engel, 1986; Lai & al., 2008).

2. **Caudalejeunea recurvistipula** (Gottsche) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1893; Mizut. in J. Hattori Bot. Lab. 64: 389. 1988. *Lejeunea recurvistipula* Gottsche in Gottsche, Lindenb. & Nees, Syn. hepat. 326. 1845.

*Specimens examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, Rabindra Nagar, c.10 m, 22.05.2008, G.K. Upadhyay 47761, 47762.

*Distribution:* India [Andaman & Nicobar Islands (Andaman)], Sri Lanka, China, Indonesia, Malaysia, Thailand, Philippines, New Caledonia, New Guinea, Micronesia, Fiji, Australia (Onraedt, 1981; Mizutani, 1988; Tan & Engel, 1986; Piippo 1990; Zhu & So, 2001; Joshi, 2001; McCarthy, 2006; Lai & al., 2008).

3. **Cololejeunea desciscens** Steph. in Hedwigia 34: 248. 1895; D.K.Singh, Sushil K.Singh & M.Dey in Phytotaxonomy 6: 100. 2006.

*Specimens examined:* Foliicolous. India: Andaman & Nicobar Islands, Little Andaman, Krishna Nala, c.25 m, 21.05.2008, G.K. Upadhyay 47751.

*Distribution:* India [Andaman & Nicobar Islands (Andaman)], Bangladesh, Sri Lanka, China, Cambodia, Indonesia, Thailand, Vietnam, Papua New Guinea (Piippo 1990; Zhu & So, 2001; Singh & al., 2006; Lai & al., 2008).

4. **Cololejeunea gottschei** (Steph.) Mizut. in J. Hattori Bot. Lab. 28: 117. 1965; G.Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60: 56. 2003. *Physocolea gottschei* Steph., Sp. hepat. 5: 894. 1916. (Fig. 1: 1 – 3)

*Specimens examined:* Follicolous. India: Andaman & Nicobar Islands, Little Andaman, Krishna Nala, c.25 m, 21.05.2008, G.K. Upadhyay 47752, 47753.

*Distribution:* India [Western Ghats (Karnataka), Andaman & Nicobar Islands (Andaman – present study)], Bangladesh, Sri Lanka, China, Cambodia, Malaysia, Thailand, Vietnam, Philippines, New Guinea (Onraedt, 1981; Zhu & So, 2001; Asthana & Srivastava, 2003; Lai & al., 2008).

5. **Lejeunea anisophylla** Mont. in Ann. Sci. Nat., Bot., Sér. 2. 19: 263. 1843; M.Dey, D.Singh & D.K.Singh in Indian J. Forest. 32: 675. 2009. (Fig. 1: 4 – 6)

*Specimens examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, South Hut Bay, c.5 m, 25.05.2008, G.K. Upadhyay 47766, 47767.

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Meghalaya, Sikkim), Andaman & Nicobar Islands (Andaman – present study)], Sri Lanka, China, Japan, Indonesia, Malaysia, Thailand, Micronesia, Hawaii, Papua New Guinea, New Caledonia, Philippines, Tahiti, Tonga, Samoa, Vietnam, Australia (Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Yamada & Iwatsuki, 2006; Zhu & So, 2001; Singh & Nath, 2007; Lai & al., 2008; Dey & al., 2009).

6. **Lejeunea flava** (Sw.) Nees, Naturgesch. Eur. Leberm. 3: 277. 1838; Sushil K.Singh & D.K.Singh in Geophytology 32: 115. 2004. *Jungermannia flava* Sw., Prodr. 144. 1788.

*Specimens examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, Rabindra Nagar, c.10 m, 22.05.2008, G.K. Upadhyay 47763.

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Assam, Meghalaya, Sikkim, West Bengal), Western Himalaya (Himachal Pradesh), Western Ghats (Karnataka, Tamil Nadu), Andaman & Nicobar Islands (Andaman)], Nepal, Bhutan, Sri Lanka, China, Indonesia, Philippines, Thailand; Japan, Korea, New Zealand, Jamaica, North & South America, Europe, Africa, Australia (Mizutani, 1971; Schuster, 1980; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Joshi, 2001; Singh & Singh, 2004; McCarthy, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh & al., 2008; Lai & al., 2008; Dey & al., 2009).

7. **Leptolejeunea balansae** Steph. in Hedwigia 35: 105. 1896; U.S.Awasthi in J. Indian Bot. Soc. 65: 119. 1986.

*Specimens examined:* Follicolous. India: Andaman & Nicobar Islands, Little Andaman, Krishna Nala, c.25 m, 21.05.2008, G.K. Upadhyay 47754, 47755.

*Distribution:* India [Eastern Himalaya (Arunachal Pradesh, Sikkim, West Bengal), Western Ghats (Tamil Nadu), Andaman & Nicobar Islands (Andaman Islands)], Cambodia, China, Indonesia, Laos, Malaysia, Thailand, Vietnam (Awasthi, 1986; Piippo, 1990; Joshi, 2001; Zhu & So, 2001; Daniels & Daniel, 2004; Singh & al., 2006, 2008; Lai & al., 2008; Dey & al., 2009).

8. **Leptolejeunea epiphylla** (Mitt.) Steph., Sp. hepat. 5: 380. 1913; D.K.Singh, Sushil K.Singh & M.Dey in Phytotaxonomy 6: 101. 2006. *Lejeunea epiphylla* Mitt. in J. Proc. Linn. Soc., Bot. 5: 118. 1861.

*Specimens examined:* Follicolous. India: Andaman & Nicobar Islands, Little Andaman, Krishna Nala, c.25 m, 21.05.2008, G.K. Upadhyay 47756, 47757, 47758.

*Distribution:* India [Andaman & Nicobar Islands (Andaman, Nicobar)], China, Sri Lanka, Thailand, Malaysia, Philippines, Japan, Papua New Guinea, Solomon Islands, Laos, Cambodia, New Caledonia, Tahiti, Africa (Herzog, 1942; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Zhu & So, 2001; Yamada & Iwatsuki, 2006; Singh & al., 2006; Lai & al., 2008).

9. **Leptolejeunea maculata** (Mitt.) Schiffn., Consp. Hep. Arch. Ind. 275. 1898. D.K.Singh, Sushil K.Singh & M.Dey in Phytotaxonomy 6: 101. 2006. *Lejeunea maculata* Mitt. in J. Proc. Linn. Soc., Bot. 5: 118. 1861. (Fig. 1: 7 – 10)

*Specimens examined:* Follicolous. India: Andaman & Nicobar Islands, Little Andaman, Krishna Nala, c.25 m, 21.05.2008, G.K. Upadhyay 47759, 47760.

*Distribution:* India [Western Ghats (Karnataka), Andaman & Nicobar Islands (Andaman)], China, Sri Lanka, Indonesia, Thailand, Philippines, New Guinea, Samoa, Australia (Onraedt, 1981; Awasthi, 1986; Tan & Engel, 1986; Zhu & So, 2001; McCarthy, 2006; Singh & al., 2006; Lai & al., 2008).

*Note:* *L. maculata* is a highly variable species, the leaf margin is usually serrate – sometimes nearly entire, underleaf lobes are uniseriate throughout or biseriate at base and uniseriate above. The ocelli are arranged in non continuous longitudinal series. However, the specimen G.K. Upadhyay 47760 is slightly atypical in having leaves usually with entire margins, rarely very slightly serrate towards apex, with the ocelli arranged in zig-zag row (Fig. 1: 7 – 9) and underleaf lobes always biseriate at base and uniseriate above (Fig. 1: 10).

**10. *Lopholejeunea subfusca*** (Nees) Schiffn. in Bot. Jahrb. Syst. 23: 593. 1897; R.L. Zhu & Gradst. in Syst. Bot. Monogr. 74: 72. 2005. *Jungermannia subfusca* Nees, Enum. Pl. Crypt. Jav. 36. 1830.

*Specimens examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, Vivekananda Nagar, c.5 m, 23.05.2008, G.K. Upadhyay 47764B.

*Distribution:* India [Eastern Himalaya (Assam, Meghalaya, Sikkim, West Bengal), Western Ghats (Karnataka, Kerala, Tamil Nadu), Andaman & Nicobar Islands (Andaman)], Bangladesh, Nepal, Bhutan, China, Sri Lanka, Thailand, Indonesia, Philippines, Malaysia, Japan, Cambodia, Vietnam, Tahiti Islands, Papua New Guinea, New Caledonia, Carolina Islands, Africa, Australia (Mizutani, 1961; Onraedt, 1981; Long & Grolle, 1990; Awasthi & al., 2000; Joshi, 2001; Zhu & Long, 2003; Zhu & Gradstein, 2005; Singh & al., 2006; McCarthy, 2006; Lai & al., 2008).

**11. *Mastigolejeunea auriculata*** (Wilson) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1895. *Jungermannia auriculata* Wilson in Drumm., Musci Amer. Exsic. no. 170. 1841. *Mastigolejeunea humilis* (Gottsche) Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 129. 1895; U.S. Awasthi & Udar in Proc. Indian Acad. Sci. (Plant Sci.) 93: 485. 1984.

*Specimens examined:* Corticolous. India: Andaman & Nicobar Islands, Little Andaman, Vivekananda Nagar, c.5 m, 23.05.2008, G.K. Upadhyay 47764A.

*Distribution:* India [Western Ghats (Kerala), Andaman & Nicobar Islands (Andaman, Nicobar)], Nepal, Bhutan, China, Sri Lanka, Thailand, Indonesia, Philippines, Malaysia, Japan, Tahiti Islands, New Guinea, New Caledonia, Caroline Islands, Moluccas, Australia (Onraedt, 1981; Awasthi & Udar, 1984; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Joshi, 2001; Zhu & Long, 2003; Yamada & Iwatsuki, 2006; McCarthy, 2006; Lai & al., 2008).

## MARCHANTACEAE

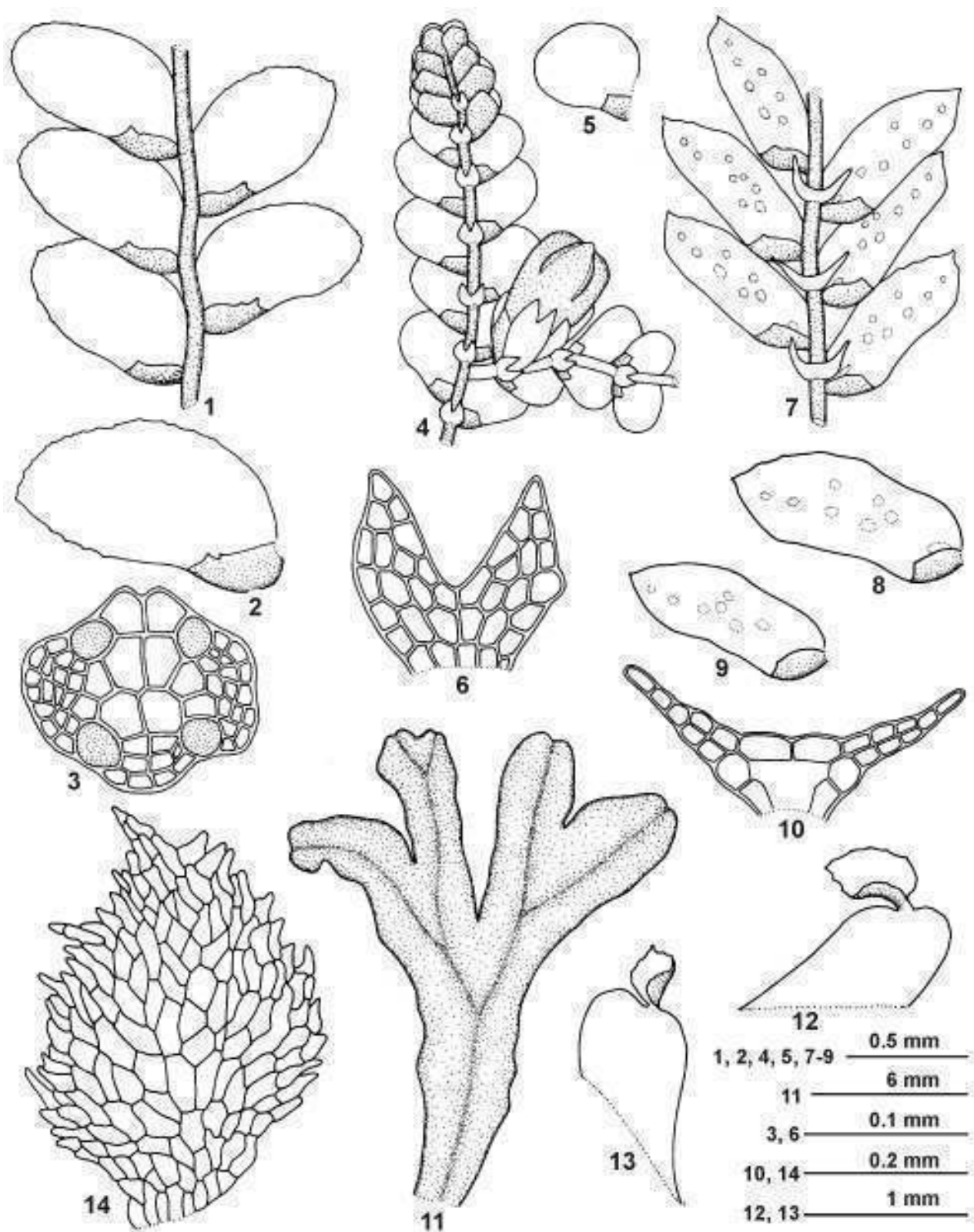
**12. *Marchantia linearis*** Lehm. & Lindenb. in Lehm., Nov. stirp. pug. 4: 8. 1832; V.B. Singh in Bull. Lucknow Natl. Bot. Gard. 125: 13. 1966. (Fig. 1: 11 – 14)

*Specimens examined:* Terricolous. India: Andaman & Nicobar Islands, Little Andaman, 4 km from Nanjappa Nagar towards Water fall, c.20 m, 16.05.2008, G.K. Upadhyay 47750.

*Distribution:* India [Eastern Himalaya (Assam, Meghalaya, Sikkim, West Bengal), Central India (Madhya Pradesh), Punjab & Rajasthan Plains (Punjab), Western Ghats (Kerala), Andaman & Nicobar Islands (Andaman – present study)], Pakistan, Nepal, Indonesia (Mitten, 1861; Chopra, 1943; Singh, 1966; Nair & al., 2005; Asthana & Nath, 2007; Singh & al., 2008).

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**Fig 1.** *Cololejeunea gottschei* (Steph.) Mizut. : 1. a portion of plant in ventral view (rhizoids not drawn); 2. a leaf; 3. a gemma; *Lejeunea anisophylla* Mont. 4. a portion of plant in ventral view (rhizoids not drawn); 5. a leaf; 6. an underleaf; *Leptolejeunea maculata* (Mitt.) Schiffn. 7. a portion of plant in ventral view (rhizoids not drawn); 8, 9. leaves; 10. an underleaf; *Marchantia linearis* Lehm. & Lindenb. 11. a portion of thallus in dorsal view; 12, 13. ventral scales; 14. an appendage (Figures 1 – 3 from G.K. Upadhyay 47752; 4 – 6 from G.K. Upadhyay 47767; 7 – 10 from G.K. Upadhyay 47760; 11 – 14 from G.K. Upadhyay 47750).



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## THE AFRICAN MOSS *TRACHYPHYLLUM DUSENII* (MÜLL.HAL. EX BROTH.) BROTH. (HYPNOBRYALES: ENTODONTACEAE) IN INDIA

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*Trachyphyllum* A. Gepp, a pleurocarpous genus with 7 species, is distributed in Asia, Africa and Australia (Buck, 1979). Bruehl (1931) included *Trachyphyllum inflexum* (Harv.) A. Gepp and *T. elongatum* Dixon & P. de la Varde in his Indian mosses. Chopra (1975) enumerated 5 species viz., *Trachyphyllum elongatum* Dixon & P. de la Varde, *T. fragilifolium* Dixon, *T. inflexum* (Harv.) A. Gepp, *T. jeyporensis* Thér. & Dixon and *T. patentifolium*, a manuscript name by P. de la Varde (vide Chopra, l.c.). Lal (2005) included 4 of the 5 species enumerated by (Chopra, l.c.) barring *T. patentifolium*.

Buck and Crum (1978) placed *Trachyphyllum elongatum* in the genus *Schwetschkeopsis* Broth. Though initially Buck (1979) placed *T. fragilifolium* in *Bryosedgwickia* Cardot & Dixon, he (Buck, 1984) later placed it in the genus *Platygyriella* Cardot. Buck (1979) also reduced *Trachyphyllum inflexum* (Harv.) A. Gepp var. *patentifolium* Dixon & P. de la Varde to a synonym of *T. inflexum*. As a result there were only 2 species viz., *Trachyphyllum inflexum* (Harv.) A. Gepp and *T. jeyporensis* Thér. & Dixon in India (vide Gangulee, 1980).

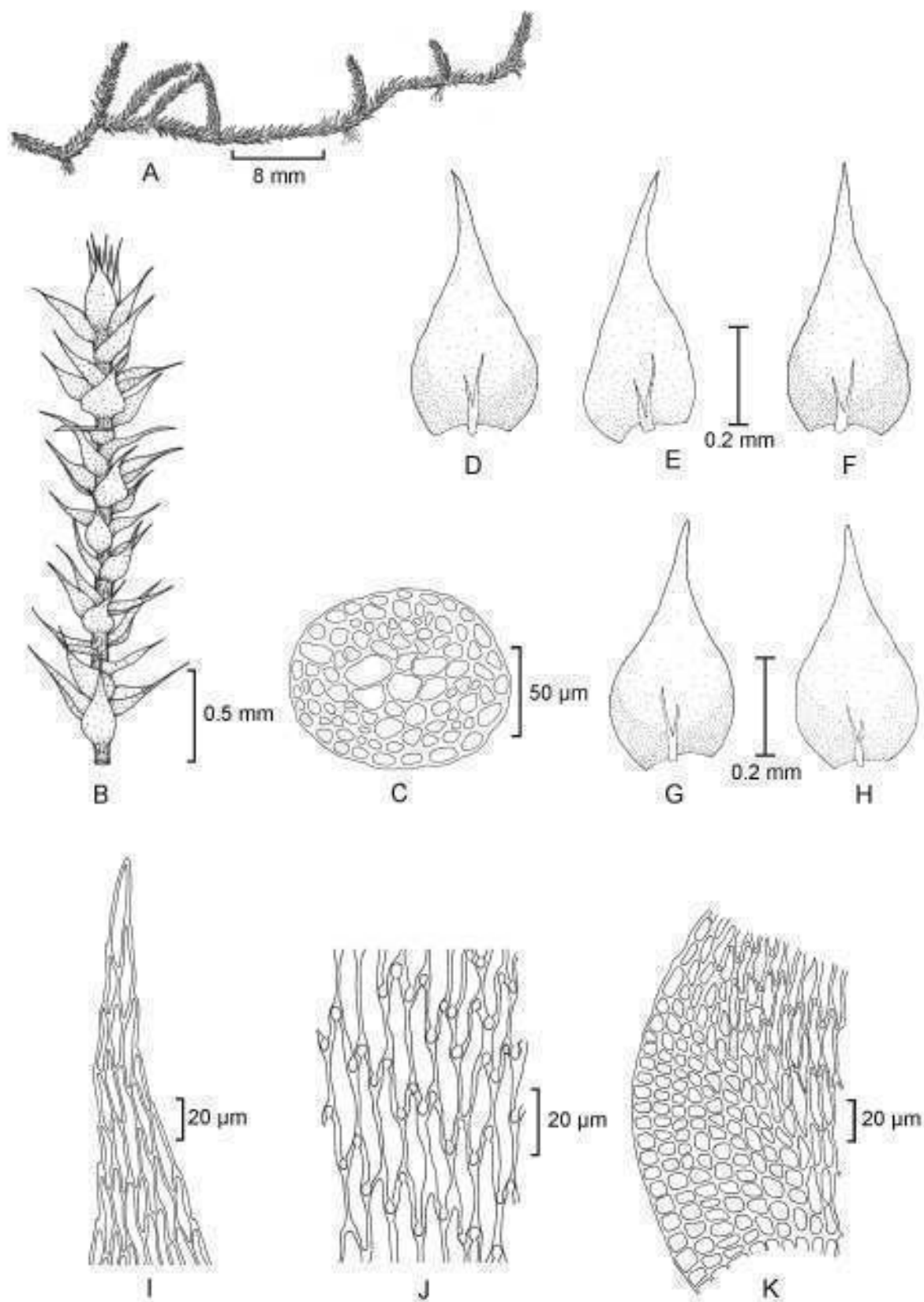
Nair & al. (2005) reported *Trachyphyllum inflexum* (Harv.) A. Gepp from northern Kerala and Manju & al. (2008) listed *T. jeyporensis* Thér. & Dixon in their checklist. The type of *T. jeyporensis* is from Jeypore in the Eastern Ghats of Orissa (Koraput Dist.). It was collected by T.L. Walker (BM, PC) in 1910 (vide Buck, 1979; Gangulee, l.c.).

During our study of the bryoflora of the Agasthayamalai Biosphere Reserve we had earlier collected material of *T. inflexum* in the Western Ghats of Tirunelveli and Kanyakumari. Recently we collected material of *T. dusenii* (Müll.Hal. ex Broth.) Broth. The present report of *T. dusenii* makes the number of species 3 in India. This species, earlier known to be distributed only in Africa (mostly in the mid-West Coast), is an addition to the bryoflora of India. Although fairly common in Africa it is rare in the Agasthayamalai Biosphere Reserve. It is described here in detail and illustrated.

***Trachyphyllum dusenii*** (Müll.Hal. ex Broth.) Broth. in Engl. & Prantl, Nat. Pflanzenfam. 1(3): 890. 1907; Buck, Brittonia 31: 387. 1979. *Pylaisia dusenii* Müll.Hal. ex Broth., Bot. Jahrb. Syst. 24: 261. 1897. - Type: Africa, Cameroon, near Ekumba-Liongo, *Dusen 810* (Lectotype: H-BR; Isolectotype: FH, vide Buck, l.c.). *Leptohymenium pinnatum* Broth. & Paris, Rev. Bryol. 29: 69. 1902. - Types: Africa, Guinea, Mt. Fonta Djallon, on granitic rocks by river Tinkisso, 20 Aug. 1901, *Maclaud s.n.* (H-BR); Kourroussa, on tree bark, Koussi, (on a Sapotaceous member), 1902, *H. Pobeguin s.n.* (H-BR). *Trachyphyllum pinnatum* (Broth. & Paris) Broth., Nat. Pflanzenfam. 1 (3): 890. 1907. (Fig.1, Plate 1)

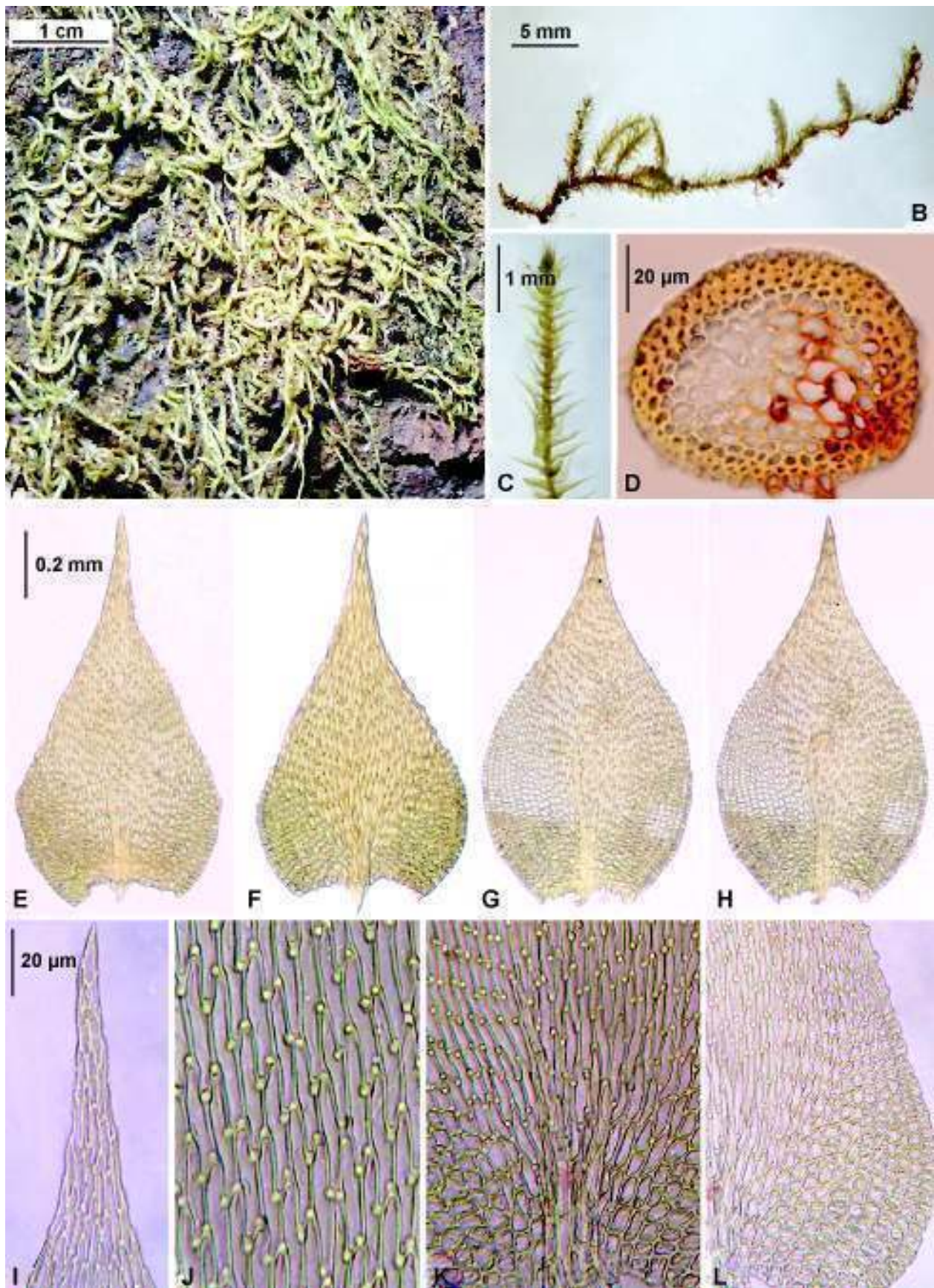
Plants forming mats, yellow-green to dull golden. Stems creeping, 2 - 3 cm long, 80 - 100 x 60 - 80 mm in cross section, ovoid, without a central strand; cortical cells 2- or 3-layered, 4 - 8 x 4 - 6 mm, rounded-quadrate, thick-walled; medullary ones 8 - 22 x 6 - 16 mm, rounded-quadrate to rounded-hexagonal, thin-walled; rhizoids arising from ventral side; branches 3 - 5 mm long, slightly curved. Leaves imbricate, erectopate, 0.48 - 0.56 x 0.2 - 0.24 mm, ovate-lanceolate to broadly lanceolate, plane to faintly concave, faintly toothed to crenulate, acute; apical and median cells 30 - 50 x 4 - 6 mm, linear, with prominent papillae on either end, sometimes epapillate at apex; basal ones at middle 20 - 30 x 4 - 6 mm, linear, papillate; alar region differentiated, ca 2/3 as long as leaf, 8 - 10-rowed at base; cells 8 - 10 x 4 - 6 mm, quadrate to quadrate-rectangular, epapillate; costa double, 1/3 - 1/4 as long as leaf. Sporophyte not seen.

**Habitat:** Corticolous on *Hopea parviflora* Bedd. (Dipterocarpaceae), a lofty tree in riparian and moist deciduous forests, endemic to the Western Ghats, ca 400 m. The Maclaud material from Guinea was corticolous on a Sapotaceous member.



**Fig. 1.** *Trachyphyllum dusenii* (Müll.Hal. ex Broth.) Broth. **A.** Habit; **B.** a portion; **C.** Cross section of stem; **D - F.** Stem leaves; **G & H.** Branch leaves; **I.** Leaf apical cells; **J.** Leaf median cells; **K.** Alar region (drawn from K.C. Kariyappa 290).





**Plate 1.** *Trachyphyllum duseonii* (Müll.Hal. ex Broth.) Broth. **A.** Habitat; **B.** Plant; **C.** Branch; **D.** Cross section of stem; **E & F.** Stem leaves; **G & H.** Branch leaves; **I.** Leaf apical cells; **J.** Leaf median cells; **K.** Leaf mid basal cells and **L.** Alar region

*Distribution:* Africa (Cameroon, Central African Republic, Ghana, Guinea, Nigeria, Senegal, Sierra Leone and Zambia) and India: Western Ghats (Tamil Nadu, Tirunelveli).

*Specimens examined:* Tamil Nadu, Tirunelveli Dist., W. Ghats, Mundanthurai, Vanathirthum, ca 400 m, 04.02.2010, K.C. Kariyappa 290 (CAL, SCCN).

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## GENUS TUYAMAELLA S.HATT. (LEJEUNEACEAE) IN INDIA

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*Tuyamaella* S.Hatt, a small genus represented by six species and two varieties, is distributed in Asiatic and oceanic region (Zhu & So, 2000a, 2001). Of these, one species and two varieties are endemic to their respective countries, viz. *T. borneensis* Tixier (Indonesia), *T. molischii* (Schiffn.) S.Hatt. var. *brevistipa* P.C.Wu & P.J.Lin (China), *T. molischii* (Schiffn.) S.Hatt. var. *taiwanensis* R.L.Zhu & M.L.So (Taiwan), *T. hattorii* Tixier is restricted to Vietnam and Laos, *T. jackii* (Steph.) Tixier is restricted to Vietnam and Kampuchea. The remaining three species show an extended range of distribution, viz. *T. angulistipa* (Steph.) R.M.Schust. & Kachroo (China, Indonesia, Malaysia, Vietnam, Kampuchea, Papua New Guinea), *T. molischii* (Schiffn.) S.Hatt. var. *molischii* (China, Japan, Malaysia, Vietnam) and *T. serratistipa* S.Hatt. (Indonesia, Papua New Guinea, Philippines, Malaysia, New Caledonia) (Tixier, 1973; Zhu & So, 1998, 2000a, b, 2001). The earlier record of *T. angulistipa* ( $\equiv$  *Pycnolejeunea angulistipa* Steph.) from India by Chopra (1943) based on Stephani's (1914) report from India Orientalis (Perak) appears to be erroneous. Perhaps for this reason the genus does not find any mention in the recent review on Indian Lejeuneaceae in India (Asthana, 2007).

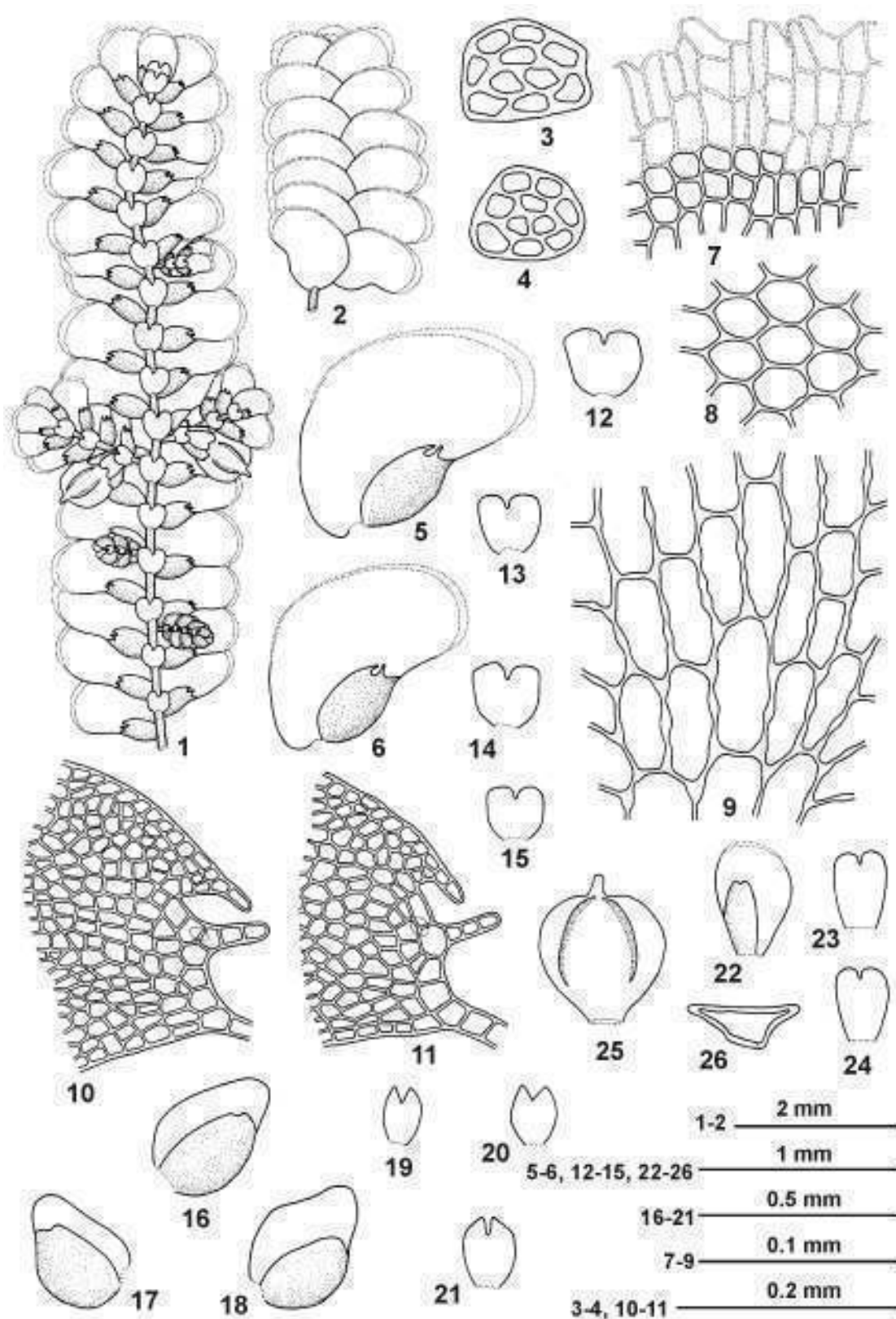
During the course of studies on the epiphyllous liverworts of Eastern Himalaya, the authors came across an interesting collection belonging to family Lejeuneaceae from West Siang district of Arunachal Pradesh which differed from all the known taxa of the family from India. Subsequent morpho-taxonomic studies on the plants followed by review of relevant literature (Tixier, 1973; Zhu & So, 1998, 2000a, b, 2001) revealed them to be *Tuyamaella serratistipa* S. Hatt., a species so far known from Indonesia, Papua New Guinea, Philippines, Malaysia and New Caledonia (Zhu & So, 1998, 2000b).

### DESCRIPTION

***Tuyamaella serratistipa*** S.Hatt. in Bot. Mag. Tokyo 64: 118. 1951; R.L.Zhu & M.L.So in J. Bryol. 20: 456. 1998.

Plants yellowish brown in herbarium, closely appressed to the substratum; shoot 9 – 17 mm long, 1.8 – 2.4 mm wide. Stem triangular – rectangular in outline in transverse section, 100 – 117.5 x 82.5 – 87.5  $\mu$ m, 4 cells across the diameter; cortical cells 7 in number, polygonal, 22.5 – 32.5 x 10 – 220  $\mu$ m, thick-walled; medullary cells 3 in number, polygonal, 17.5 – 30 x 10 – 22.5  $\mu$ m, thick-walled; ventral merophytes of stem 2 cells wide. Leaves imbricate, widely spreading; leaf lobe oblong-ovate, 1.1 – 1.3 mm long, 0.7 – 0.9 mm wide, apex rounded, margin irregular, apical and dorsal margin bordered by 1 – 3 rows of hyaline cells, ventral margin lacking such hyaline cells, dorsal margin strongly arched, ventral margin slightly arched; hyaline marginal leaf cells rectangular, 12.5 – 45 x 7.5 – 17.5  $\mu$ m, walls thin, trigones and intermediate thickenings absent; median leaf cells hexagonal, 15 – 30 x 12.5 – 22.5  $\mu$ m, walls thin with minute trigones, intermediate thickenings absent; basal leaf cells elongated, polygonal, 25. – 67.5 x 12.5 – 30  $\mu$ m, walls slightly thick with large trigones, intermediate thickenings frequent; cuticle smooth; oil bodies not seen; leaf lobule inflated, 1/3 – 2/5 as long as the lobe, ovate, 0.44 – 0.52 mm long, 0.23 – 0.30 mm wide, bidentate; first tooth 3 – 4 cells long, 1 cell wide; second tooth 3 – 4 cells long, 2 – 3 cells wide at base, uniseriate above; hyaline papilla oblong, present at the inner surface of the base of first tooth; keel arched, smooth. Underleaves distant, obcordate, 2 – 3 times as wide as the stem, 0.28 – 0.35 mm long, 0.27 – 0.33 mm wide, bilobed to 1/4 underleaf length, margin entire, apex of lobes rounded – slightly truncate, sinus narrow. Rhizoids numerous, fasciculate at the base of underleaves. Gemmae not seen.

Monoecious. Androecia terminal on short lateral branches, rarely intercalary; male bracts in 3 – 5 pairs, densely imbricate; bract lobe oblong-ovate, 0.27 – 0.35 mm long, 0.17 – 0.23 mm wide, apex rounded – obtuse,



**Figs. 1 – 26.** *Tuyamaella serratistipa* S.Hatt. **1.** A portion of plant in ventral view (rhizoids not drawn); **2.** The same in dorsal view; **3, 4.** Transverse sections of stem; **5, 6.** Leaves; **7.** Apical leaf cells; **8.** Median leaf cells; **9.** Basal leaf cells; **10, 11.** Apices of leaf lobules; **12 – 15.** Underleaves; **16 – 18.** Male bracts; **19 – 21.** Male bracteoles; **22.** Female bract; **23, 24.** Female bracteoles; **25.** A perianth in ventral view; **26.** Transverse section of perianth.



margin entire; bract lobule strongly inflated,  $2/3 - 3/4$  as long as the bract lobe; male bracteoles 3 – 5, present throughout the androecium, 0.11 – 0.16 mm long, 0.07 – 0.13 mm wide. Gynoecia terminal on short lateral branches with a single sub-floral innovation; female bract lobe obovate, 0.6 – 0.9 mm long, 0.37 – 0.72 mm wide, apex rounded, margin entire, apical margin bordered by 1 – 3 rows of hyaline cells; bract lobule  $1/3 - 2/3$  as long as the bract lobe, apex bi-dentate, margin entire; female bracteole oblong-ovate, 0.43 – 0.47 mm long, 0.28 – 0.31 mm wide, bilobed to  $1/6 - 1/5$  of their length, margin entire, apex of lobes rounded, sinus narrow; perianth obovate, 0.70 – 0.77 mm long, 0.55 – 0.59 mm wide; keels 4 (2 lateral, 2 ventral), smooth; beak 4 – 5 cells long. Mature sporophyte not seen.

*Habitat and ecology*: Epiphyllous, forming compact patches on the leaves of *Phrynium* sp. in moist and shady places.

*Specimen examined*: India: Eastern Himalaya, Arunachal Pradesh, West Siang, on way to Bulli from Kaying, c. 1200 m, 04.12.1984, D.K. Singh 362/1984 (ASSAM, CAL).

*Distribution*: India (Arunachal Pradesh – present study), Indonesia, Papua New Guinea, Philippines, Malaysia, New Caledonia.

## DISCUSSION

*Tuyamaella serratistipa* is characterized by oblong-ovate leaf lobes with rounded apices bordered by 1 – 3 rows of hyaline cells (Figs. 5 – 7); bidentate leaf lobules with first tooth 3 – 4 cells long, second tooth 3 – 4 cells long, 2 – 3 cells wide at base, uniseriate above (Figs. 10, 11); obcordate underleaves bilobed to  $1/4$  of its length with rounded – slightly truncate lobe apices (Figs. 12 – 15); obovate perianth with 4 smooth keels (Figs. 25, 26).

Indian plants of *T. serratistipa*, however, are slightly atypical as they lack *Allorgella*-type denticulations along the lateral margins of underleaves and the gemmae, and have 4–5 cells long perianth beak as compared to smaller, 2 – 3 cells long beak observed by Zhu and So (1998).

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## STATUS OF *CORYDALIS MEIFOLIA* VAR. *VIOLACEA* (FUMARIACEAE) AND A NEW VARIETAL RECORD FOR INDIA

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Nathaniel Wallich described *Corydalis meifolia* Wall. [Tent. Fl. Nepal.: 55, t. 41. 1826] based on the collection from Kumaon Himalaya. The species was distinguished by its unique foliage, with leaves dissected into linear filamentous segments (Fig. 3C). Vicary in 1831 collected purple-flowered *Corydalis* at Baorin Ghattee, North India [Vicary no. 50, lectotype, (CAL!)] and named it as “*C. violaceus*, nom. herb.”, but never published it. Prain (1896) considered Vicary’s specimens as distinct, but closely allied to *C. meifolia* Wall., hence described them as *C. meifolia* Wall. var. *violacea* Vicary ex Prain. Besides Vicary’s collection from Garhwal, Prain (l.c.) included four more specimens in the protologue of his new variety. Of these Duthie’s collection [No. 956] was from Garhwal in Uttarakhand, whereas those of Edgeworth, Brandis and Jaeschke were from Lahul in Himachal Pradesh. Ellis and Balakrishnan (1993) erroneously placed it under synonym of the typical variety, as the description given by them is representative of the typical plants and does not include the exclusive characters of var. *violacea*. Prain (l.c.) pointed that specimens referred to *C. meifolia* var. *violacea* by him were distinguishable by important morphological characters of comparative length of upper petal lamina and spur and suggested a possible species rank for the same.

During a recent field survey in the Gangotri National Park, Western Himalaya, India, one of us (PKP) collected plants akin to *C. meifolia* var. *violacea*. A detailed morpho-taxonomic study on these fresh collections along with the type specimen of var. *violacea* in CAL and other specimens housed in DD and BSD, hitherto referred to *C. meifolia* Wall., revealed that the taxon under consideration differs in many additional morphological characters as listed in following key. Since in our opinion these characters are enough to treat variety *violacea* at species rank, the same is raised here at the species rank. The two species can be distinguished as follows:

- 1a Flowers pinkish-purple or purple, with white spur; spur longer than broad, 1/2–1/3<sup>rd</sup> the length of upper petal (including spur); ultimate leaf segments linear to linear-elliptic with close segmentation; bracteoles usually shorter than pedicels; dorsal wing of upper petal tapered smoothly without abrupt constriction *C. violacea*
- 1b. Flowers yellow or orange-yellow; spur yellow, orange or black-tipped reddish-maroon; spur as long as broad, (1/4–)1/5–1/7th the length of upper petal (including spur); ultimate leaf segments linear or linear-lanceolate with lax segmentation; bracteoles usually as long as or longer than pedicels; dorsal wing of upper petal broadly rounded on hood, then abruptly narrowed and tapered at/on spur base (dorsal wing very narrow or absent in *C. meifolia* var. *ecristata*) *C. meifolia*

During the course of this study authors also came across few collections of *C. meifolia* Wall., collected from Chamoli district of Uttarakhand (Garhwal), differing from the typical plants in upper and lower petals being wingless/ecristate or very narrowly winged with sub-acute or obtuse tips and white membranous inner petals without black or dark purplish-brown tips. Review of relevant literature (Royle, 1834-39, Hooker & Thomson, 1855; Hooker, 1872; Prain, 1896; Jafri, 1974; Polunin & Stainton, 1984; Long, 1984; Lidén, 1989; Ellis & Balakrishnan, 1993, Press & al, 2000; Zang & al., 2008) revealed the identity of these specimens as *C. meifolia* Wall. var. *ecristata* C.Y. Wu & Z.Y. Su, a taxon hitherto known from China (Tibet) only. The same is described and illustrated as a new record for Indian flora. A key to the Himalayan species of ‘*meifolia*’ group has been provided.

***Corydalis violacea*** (Vicary ex Prain) Pusalkar & D.K.Singh, **comb. et stat nov.** *C. meifolia* Wall. var. *violacea* Vicary ex Prain in J. Asiat. Soc. Bengal II, 65: 49. 1896.

Perennial herb with spreading foliage and erect to ascending flowering stems, 15–40 cm high; storage rootstock thick, 1–2.5 cm broad, often comprising many strands and crowned with scarious, membranous and fibrous remains of petiole bases. Leaves mostly basal, many, long petioled; petiole 1–10 cm long, glabrous, flat, with broadened sheathing base; lamina oblong or oblong-elliptic in outline, 3-pinnatisect, 6–15 x 3–4 cm; primary pinnae oblong-lanceolate to ovate-oblong in outline, opposite to alternate, lower petioluled, upper subsessile to sessile, to 3 x 1.5 cm; ultimate segments/lobules linear-laciniate to narrowly elliptic-linear, cuspidate, 2–5 x 0.2–1 mm, glabrous, glaucous. Cauline leaves 1–3 pairs, opposite to sub-opposite, sometimes upper alternate; lower pair petioled, upper sessile or sub-sessile. Flowers purple or pinkish-purple with white spur, 12–15 mm long, arranged in terminal, simple, usually flat-topped corymbose raceme, on scape-like branches arising from the axis of basal leaves; lowermost bracteoles leaf-like, upper 2-pinnatisect, flabellately divided into linear-laciniate segments; pedicels filiform, to 3.5 cm long, exceeding bracteoles. Sepals 2, lateral, ovate, 0.8–1 x 0.8–1.2 mm, fimbriate-dentate, white, membranous, glabrous. Petals 4, outer 2 (upper and lower) dissimilar, free; inner 2 similar, cohering at tip. Upper (posterior/posticous) petal 12–15 mm long, basally spurred; limb 8–11 mm long, dorsally winged with wing rounded on hood then smoothly narrowed, apex obtuse; spur conical, obtuse, 4–5 mm long, 2–3 mm broad at base, longer than broad, 1/2–1/3rd the upper petal; nectary within spur, attached to the base, 1–1.5 mm long, not fused with spur wall. Lower (anterior/anticous) petal 8.5–11 mm long, base not saccate; lamina 4.7–5.3 mm long, dorsally winged, deflexed at maturity. Inner petals 2, cohering at tip, 8–9.5 mm long, dorsally winged, basally clawed; claw 0.5–1 mm long, curved or straight, spreading. Stamens 6, in two bundles; each bundle with central ditheous and lateral monothecous anthers; phalange forming membranous covering around carpel. Carpels 2; ovary 2–3 mm long, elliptic, glabrous; style 2.5–3.5 mm long, apically upcurved; stigma showing apical and lateral lobes with basal lobules, papillate. Capsules broadly elliptic-oblongoid, 7–12 mm long, biconvex, glabrous, with persistent style and stigma; seeds 5–7, biseriate or sub-biseriate, sub-orbicular, 1–1.3 mm across, black, glossy with attached caruncle.

*Flowering & Fruiting*: June (late)–September (late).

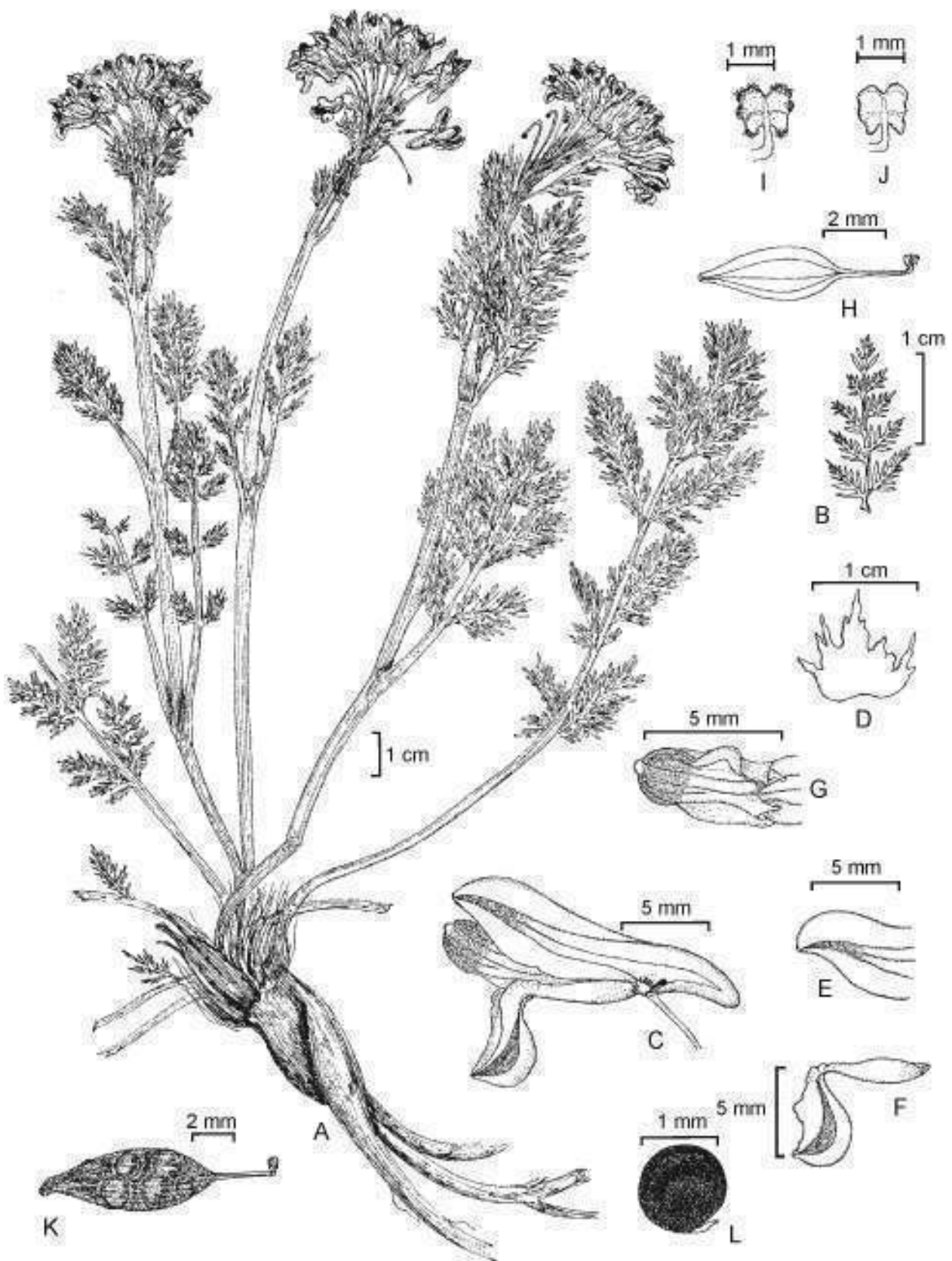
*Habitat & Ecology*: Occasional, amidst scree and rocks in lateral and supra-glacier moraines, often on boulder-strewn slopes bordering glacier lakes, rarely on rocky-grassy slopes between 4300–5300 m.

*Specimens Examined*: Uttarakhand: Uttarkashi district: Tehri Garhwal (now Uttarkashi), Gangotri, 4000–4242 m, August 1897, Keshvanand 16 (DD); Dudu gad under Srikanta, 4545–4850 m, 09.08.1883, J.F. Duthie 956 (DD); Ourie gad in Nila valley, 4242–4545 m, 15.08.1883, J.F. Duthie 956 a (DD); Gangotri National Park, Tapovan, 4200–4700 m, 23.09.1967, B.D. Naithani 37413 (BSD); Gangotri National Park, near Kedar Tal, 4500–5000 m, 31.07.002, Pusalkar 101767 (BSD); Kedar Ganga valley, on way to Thalayasagar Peak, 5000–5200 m, 04.08.2003, Pusalkar 103961 (BSD); Tehri district: Sahastra Tal, 5300 m, 16.09.1979, A.K. Goel 66053 (BSD); HIMACHAL PRADESH: Kinnaur district, Rupin Pass, 4764 m, 24.09.1964, N.C. Nair 34256 (BSD); Chitkul, left river bank, 21.09.1974, K.P. Janardhanan 53621 (BSD).

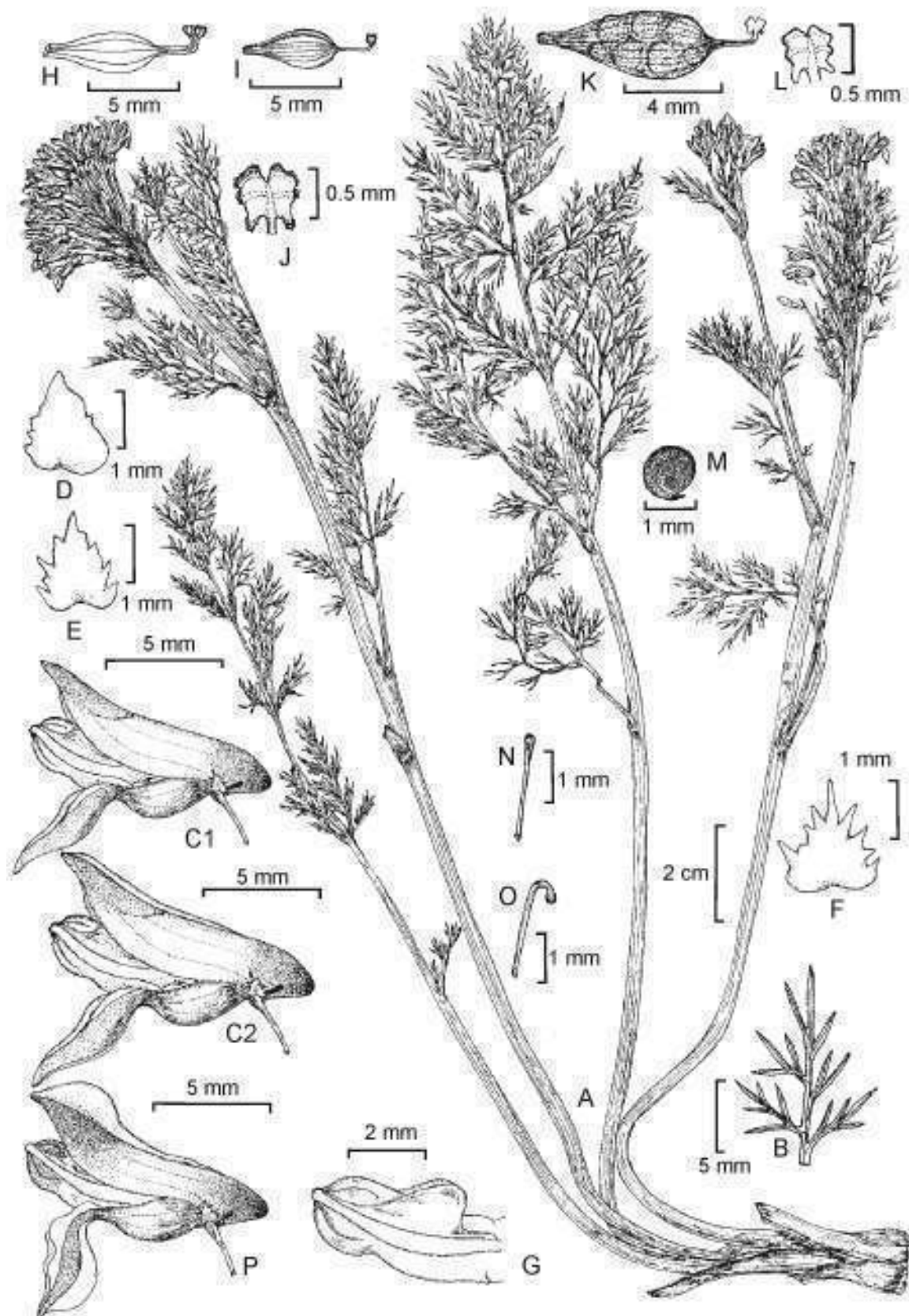
*Distribution*: INDIA [Western Himalaya: Himachal Pradesh, Uttarakhand], Endemic.

***Corydalis meifolia*** Wall. var. ***ecristata*** C.Y. Wu & Z.Y. Su in C.Y. Wu, Fl. Xizang. 2: 312. 1985. *Corydalis lhasaensis* C.Y. Wu & Z.Y. Su in C.Y. Wu, Fl. Reipubl. Popularis Sin. 32: 280.1999. (Fig 2, 3B)

Perennial herb with spreading foliage and erect to ascending flowering stems, 8–35 cm high; rootstock long, thick; stems 2-many, arising from the axis of the basal leaves, tufted, striate, glaucous or glabrous, base with column of persistent broad, sheathing petiole bases. Foliage green or greyish-green, glabrous or glaucous. Leaves deeply and finely divided into linear-lanceolate to linear-elliptic or linear-laciniate ultimate segments; basal leaves large, long petioled; petioles 2–17 cm long, with broadly flattened, sheathing base, often with thin, scarious margins; lamina oblong-elliptic in outline, 3-pinnatisect, 8–20 x 2–7 cm; primary pinnae 5–7 pairs, ovate-lanceolate to oblong-elliptic in outline, 2–7 x 1–3 cm, pinnate or bipinnatifid; ultimate segments linear-lanceolate to linear-elliptic or laciniate, numerous, 2–5 x 0.3–1 mm; cauline leaves few, alternate to opposite; lowermost situated near the middle of stem, becoming shorter and sub-sessile above, 2-pinnatifid upwards. Flowers yellow with green hood and black-tipped spur showing reddish-maroon base, 10–15 mm long, in terminal, densely 10–20-flowered, flat-topped, corymbose raceme, to 8 cm long, elongated in fruiting; bracts equaling or exceeding the pedicels; lower bracts leaf-like, 2-pinnatisect into similar linear segments like foliage



**Fig. 1.** *Corydalis violacea* (Vicary ex Prain) Pusalkar & D.K. Singh. - **A.** Habit; **B.** Leaf pinna showing segmentation, **C.** Flower; **D.** Sepal; **E.** Upper petal apex showing dorsal wing; **F.** Lower petal showing lateral wing variation; **G.** Inner petal; **H.** Phalange with anthers; **I.** Flowering stigma with papillae; **J.** Fruiting stigma; **K.** Capsule; **L.** Seed.



**Fig. 2.** *Corydalis meifolia* Wall. var. *ecristata* C.Y. Wu & Z.Y. Su: **A.** Habit; **B.** Leaf pinna showing segmentation; **C1.** Flower showing wingless upper/lower petal; **C2.** Flower showing narrowly winged upper/lower petal; **D, E, F.** Sepal (variation); **G.** Inner petal; **H.** Phalange with anthers; **I.** Carpel; **J.** Flowering stigma (with papillae); **K.** Capsule; **L.** Fruiting stigma (without papillae); **M.** Seed; **N.** Flowering pedicel; **O.** Fruiting pedicel; **P.** flower of *C. meifolia* Wall. var. *meifolia* showing, broadly winged upper/lower petal.



**Fig. 3.** **A.** *Corydalis violacea* (Vicary ex Prain) Pusalkar & D.K. Singh; **B.** *Corydalis meifolia* Wall. var. *ecristata* C.Y. Wu & Z.Y. Su; **C.** *Corydalis meifolia* Wall. var. *meifolia*

and broad sheathing petiole; median bracts flabellate, palmately pinnatisect with flattened bases and deeply divided linear segments; pedicels 1–3 cm long, glaucous; flowering pedicels erect; fruiting pedicels apically curved. Sepals 2, lateral, ovate, ovate-cordate or ovate-reniform 1.5–2 x 1–1.5 mm, white, membranous, glabrous, margins wavy to irregularly fimbriate-dentate. Petals 4, outer 2 (upper and lower) dissimilar, free; inner 2 similar, cohering at tip. Upper (posterior/posticous) petal 10–15 mm long, spurred; petal lamina 8–12 mm long, yellow with green hood, often with purple lines on the neck, dorsally wingless or very narrowly winged, apex sub-acute; spur conical-saccate, as long as broad, 3–4 x 3–4 mm, obtuse, 1/5–1/6th the length of upper petal (including spur); nectary 0.8–1.2 mm long, attached to the spur base, not fusing with spur wall. Lower (anterior/anticous) petals yellow with basal part flushed with reddish-maroon, 8–12 mm long, equaling or exceeding upper petal lip, narrowed in the middle with 4–6 mm long, non saccate or sub-saccate base and 4–6 mm long limb; limb dorsally wingless or narrowly winged, deflexed, with sub-acute tip and lateral variable wings. Inner petals cohering at apex, creamy-white, sub-membranous, not black or dark-tipped, 6–8 mm long; lamina 4–6 mm long, apically rounded, obtusely mucronate snout, dorsally narrowly and laterally auriculate winged; base auricled, clawed. Stamens in two bundles, each with central ditheous and lateral pair of monotheous anthers; filaments forming white, membranous phalange enclosing ovary and style; anthers minute, 0.8–1 mm long, reaching stigma. Carpels 2, united; ovary oblanceolate or obovate, flattened, biconvex, 3–5 mm long with 2–3 mm long, apically upcurved style bearing 0.6–1 x 0.5–1 mm, flattened, bilobed, fused stigma, squarish in outline bearing 4 apical and 2 inconspicuous lateral papillate lobes with basal papillate lobes. Capsules narrowly obovoid, oblanceoid to broadly ellipsoid, 6–10 x 3–5 mm with persistent style and stigma; fruiting stigma glabrous, usually without papillae; seeds (4–) 6–10, biseriate or sub-biseriate, orbicular or sub-orbicular, often flattened or biconvex, 1–1.5 mm across, black, smooth or faintly foveolate, glossy, with attached caruncle.

*Flowering & Fruiting:* July–September.

*Habitat & Ecology:* Locally common, on open grassy slopes bordering glacier between 3400–4500 m.

*Distribution:* INDIA [Western Himalaya: Uttarakhand (Chamoli district)], CHINA (Tibet-Lhasa).

*Specimens examined:* Uttarakhand, Chamoli district, Nandadevi Biosphere Reserve, Hemkund, 4200 m, 02.10.1962, U.C. Bhattacharyya 24265 (BSD); Hemkund, 4000 m, 17.08.1963, U.C. Bhattacharyya 29482 (BSD); Valley of Flowers, May 1978, B.M. Wadhwa 62661 (BSD); Chamoli, B.P. Uniyal 89227 (BSD); On way to Hemkund, 18.10.1965, N.C. Nair 85950 (BSD); Lakshman Parbat, on way to Hemkund, 1.8–2.5 Km behind Lake/Shrine, 3800 m, 07.08.2008, Pusalkar 111131 (BSD).

#### KEY TO *CORYDALIS MEIFOLIA* GROUP OF THE HIMALAYA

- 1a. Spur as long as broad, (1/4–)1/5–1/7th the length of upper petal (including spur) ..... 2
- 1b. Spur longer than broad, 1/2–1/3rd the length of upper petal (including spur) ..... 3
- 2a. Upper and lower petal wingless ..... *C. meifolia* Wall. var. *ecristata* C.Y. Wu & Z.Y. Su [Himalaya: China (Tibet, Lhasa), India (Uttarakhand, Chamoli)]



- 2b. Upper and lower petal broadly winged ..... *C. meifolia* Wall. var. *meifolia*  
[Himalaya: Bhutan, China, India (Jammu & Kashmir to Sikkim), Nepal, Pakistan]
- 3a. Flowers yellow; plant base with membranous remains of petiole bases; flowers 5–8; stigma with reduced basal lobes ..... *C. sikkimensis* (Prain) Fedde  
[Himalaya: Bhutan, India (Uttarakhand, Sikkim), Nepal]
- 3b. Flowers purple with white spur; plant base with fibrous remains of petiole bases; flowers 10–20; stigma with well-developed basal lobes ..... *C. violacea* (Vicary ex Prain) Pusalkar & D.K. Singh  
[Western Himalaya: India (Himachal Pradesh, Uttarakhand)]

#### ACKNOWLEDGEMENTS

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## ISOTACHIS INDICA MITT. (HEPATICAE): AN ENDEMIC AND THREATENED LIVERWORT REDISCOVERED FROM MEGHALAYA, INDIA

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The genus *Isotachis* Mitt. (Balantiopsaceae) is represented by 26 species in the world (Hatcher, 1960, 1961; Schuster & Engel, 1997), distributed mainly in tropical and subtropical regions of Asia, Africa, Australia and New Zealand. In India, it is represented by three species, viz. *I. indica* Mitt., *I. armata* (Nees) Gottsche and *I. japonica* Steph., all confined to hilly regions especially Eastern Himalaya and NE India (Srivastava and Rawat, 2001; Das & Singh, 2007; Singh & Singh, 2009).

*Isotachis indica* was originally described by Mitten (1861) on the basis of collection made by J.D. Hooker and T. Thomson from Khasi Hills of Meghalaya more than 150 years ago. Afterwards, this species could never be collected again since its original collection. Hatcher (1961) and Srivastava and Rawat (2001) provided detailed taxonomic description of this species based on its type collection only. It is worthwhile to mention that this area is comparatively well explored and the Hepaticae of Khasi and Jaintia Hills have already been documented (Singh & Nath, 2007), but without any mention of this species.

Recently during an exploration near Mawsinram in the East Khasi Hills district of Meghalaya in the month of July 2010, a population of dark brown plants was observed by one of us (SKS). Subsequent morpho-taxonomic study revealed them to be *Isotachis indica* –an endemic species confined to Meghalaya alone, after a gap of about 150 years. It is interesting to note that this is only the second location of its occurrence other than its type locality Cherrapunjee (Churra) in the East Khasi Hills of the State.

**Isotachis indica** Mitt. in J. Proc. Linn. Soc., Bot. 5: 100. 1861; Hatcher, Nova Hedwigia 2 (4): 592.1960; Srivastava & Rawat in Curr. Sci. 80: 1484, 2001. (Figs. 1& 2).

Plant dark-brown, 60-80 mm long, 3-4 mm wide; branching lateral intercalary. Stem in cross-section suborbicular in outline, 444-507 x 324-440 mm, 11-14 cells across diameter, differentiated into cortical and medullary zones; cortical cells thick-walled, in 1-2 layers, subglobose-subquadrate, 23-50 x 15-30 mm, light brown; medullary cells thin-walled, slightly larger, oval – polygonal 40-60 x 20-43 mm, hyaline, trigones minute, triangular. Leaves incubous, alternate, imbricate above, occasionally approximate below, obliquely inserted, broadly ovate or rectangulate, 2.3-2.6 mm long, 1.6-1.8 mm broad, bilobed to 1/5 -1/4 (-1/3) of its length, dentate at margin, dentition up to 20 per leaf, 1-5 cell long, 1-2 (-3)-celled uniseriate at apex, acute, 2-3 cell broad at base; apical leaf cells triangular to subquadrangular 45-92.5 x 20-40 mm; median leaf cells pentagonal to hexagonal, 75-115 x 15-32.5 mm; basal leaf cells slightly elongated to rectangulate, 75-137.5 x 20-30 mm, cells thin-walled with minute triangular trigones; cuticle striolate-papillose. Underleaves overlapping, suborbicular to ovoid, 1.8-2 mm long, 1.5-1.8 mm wide, bilobed to (-1/5) 1/4 -1/3 (-1/2) of its length, lobes divergent; sinus shallow to deep, triangular or auriculate, margin dentate, dentition 10-18 per underleaf, acute, 1-4 cell long, 1-2 (-3)-celled uniseriate at apex, 2-4 cell wide at base. Fertile plant not seen.

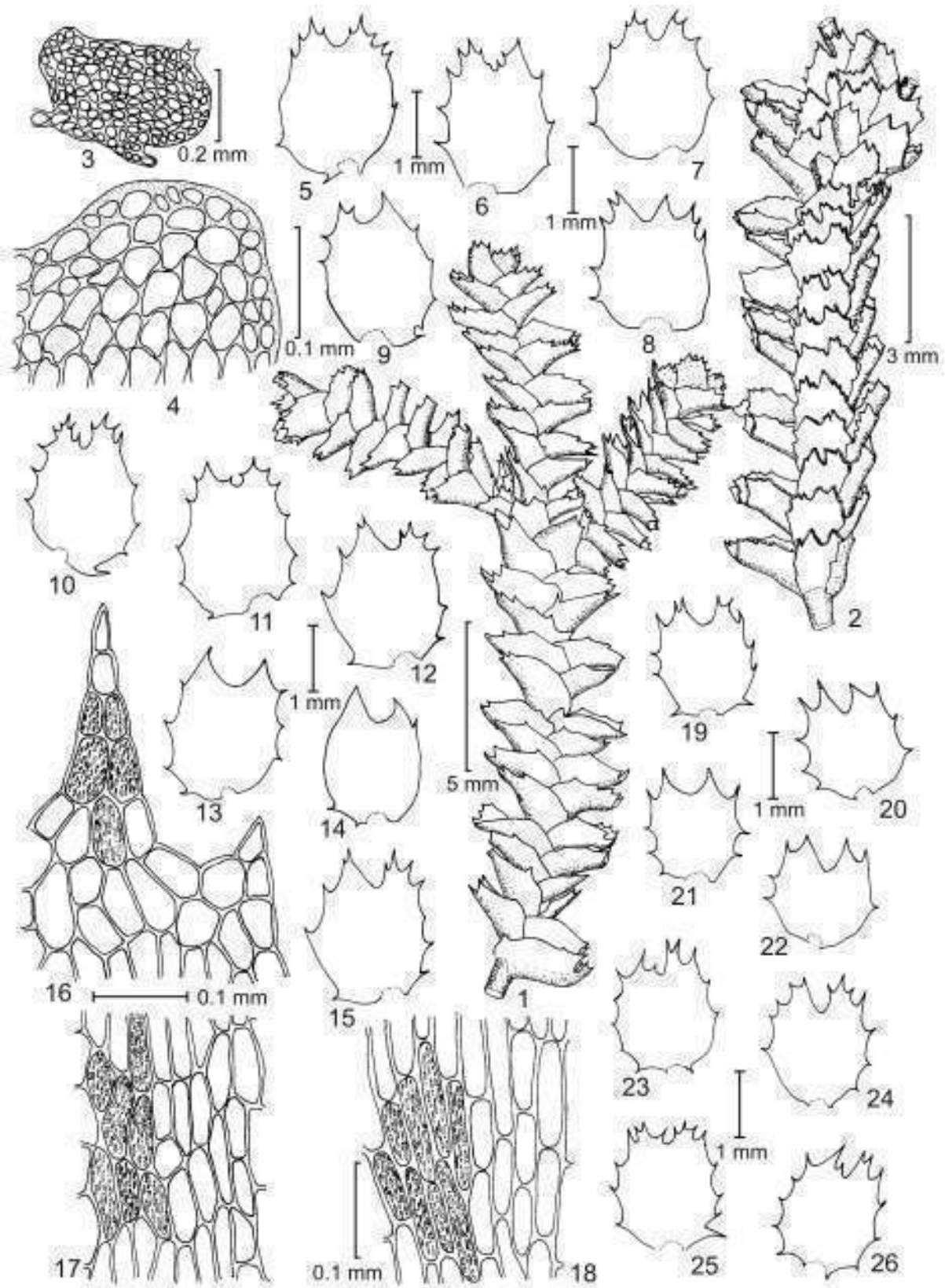
*Specimen examined:* Growing over thin layer soil on very moist rock surface at Mawsinram area (altitude ca 1200m), 23.07.2010, S.K.Singh 118701(ASSAM).

*Distribution:* INDIA: Meghalaya (East Khasi Hills: Near Churra; near Mawsinram –present study). Endemic.

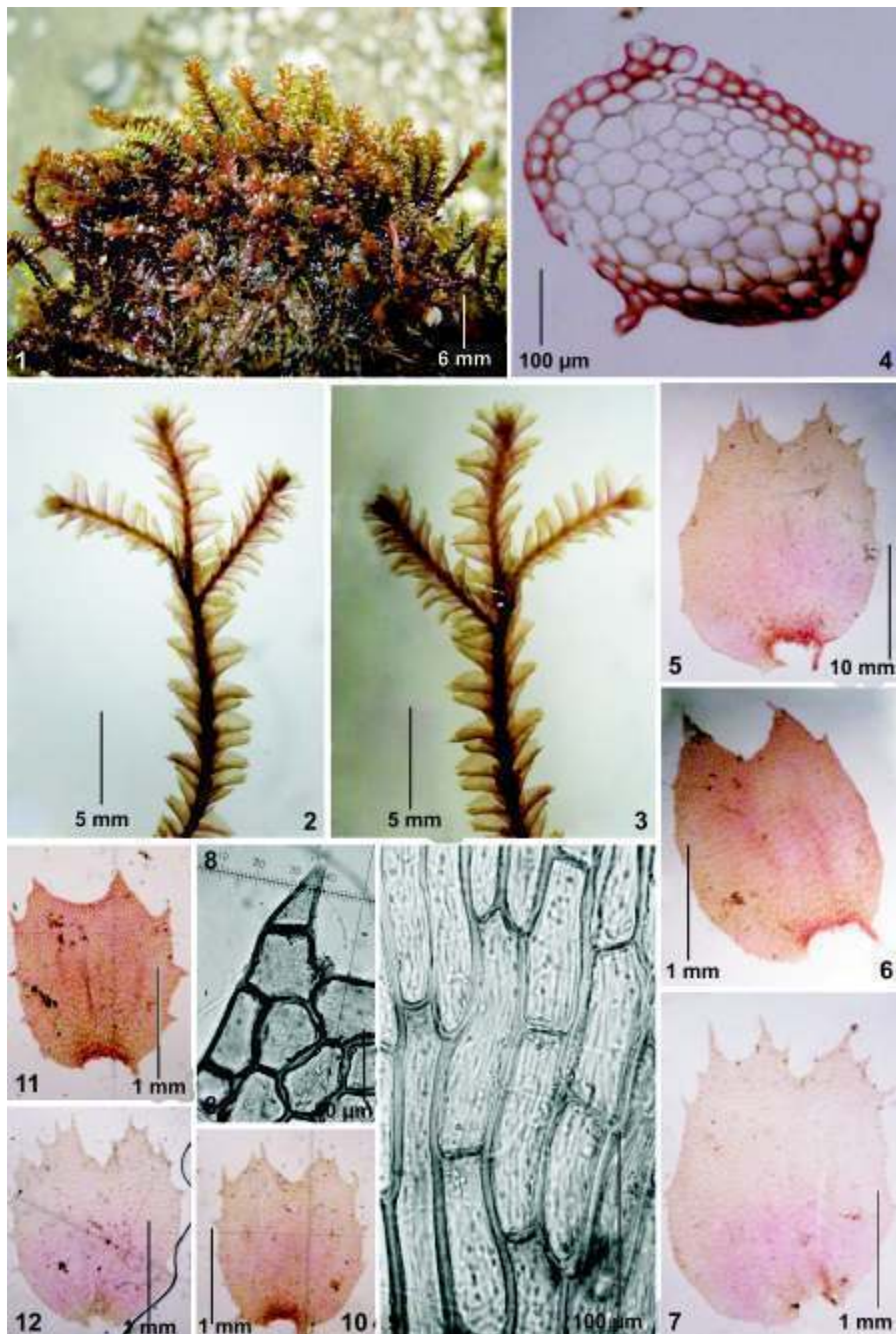
*Conservation status:* As the species is so far known from only two locations, including the type locality which of late has been under considerably stress because of the lime stone mining activities for the cement factories located closeby. Following the criteria of IUCN category, this species may be treated in Endangered (EN) category as it is distributed within the area less than c. 30 sq km.

*Isotachis indica* is closely allied to *I. japonica*. However, former is clearly distinct from the latter by having bifid leaves which is occasionally trifid while the leaves of *I. japonica* are characteristically bis-bifid to





**Fig. 1.** *Isotachis indica* Mitt. 1. A portion of the plant in dorsal view. 2. The same in ventral view. 3. Cross section of stem. 4. A portion of the same magnified. 5-15. Leaves. 16. Marginal leaf cells towards apex. 17. Median leaf cells. 18. Basal leaf cells. 19-26. Underleaves.



**Fig. 2.** *Isotachis indica* Mitt. 1. Habit. 2. A portion of plant in dorsal view. 3. The same in ventral view. 4. Cross Section of the stem. 5-7. Leaves. 8. Marginal cells towards apex. 9. Basal leaf cells. 10-12. Underleaves.

occasionally trifold (Hatcher, 1960, 1961; Srivastava & Rawat 2001; Singh & Singh, 2009). Hatcher (1961) also emphasized on the differences in underleaves of the two species with the former having dentate to ciliate-dentate margins as against dentate margin in the latter.

#### ACKNOWLEDGEMENTS

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## NOTES ON *LITSEA BEEI* N. MOHANAN & E.S.S. KUMAR (LAURACEAE)

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*Litsea beei* N. Mohanan & E.S.S.Kumar collected from Agasthamala Hills, was published as a new species and was considered in the protologue as allied to Burmese element *L. myristicaefolia*. (Mohanani & Kumar, Nordic J. Bot. 23(5):611.2004). Taxonomic revision of the genus in India was undertaken by the present authors under Flora of India project. The critical and detailed taxonomic studies on the herbarium material revealed that *L. beei* is not related to *L. myristicaefolia* and in fact the two species belong to different sections of the genus. Arrangement of male umbellules is similar in *L. beei* (clearly provided in the protologue) as well as in *L. venulosa*. Moreover, the morpho-taxonomical characters of leaves, inflorescence and fruits in *L. beei* are falling within the circumscription of *L. venulosa*. In the present paper the former has been treated as a synonym of the latter.

Following is a brief description of the species, with correct nomenclature and distribution:

***Litsea venulosa*** (Meisn.) Hook. f., Fl. Brit. India.5: 161. 1886; Gamble, Fl. Madras 1235. 1925 (reprint 2: 865. 1957); Rao, Flow. Pl. Travancore 345. 1914; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 1: 66. 1986; V. Chandras. in A. N. Henry, Kumari & Chithra, Fl. Tamil Nadu Analysis 2: 211. 1987; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 396. 1994. *Tetranthera venulosa* Meisn. in DC., Prod. 15(1): 187.1864. Type: Peninsular India *Wight* s.n. (K photo!). *L. beei* N. Mohanan & E.S.S.Kumar, Nordic J. Botany 23 (5): 611. 2004. **syn. nov.** Type: India, Kerala, Thiruvananthapuram district, Agasthamala Hills, Attayar, 700 m, 27.6.1994, *Mohanani TBGRI 12439* (holotype TBGT, photo!)

(Plate 1)

Straggling shrubs, 5 - 6 m tall, evergreen, winter buds absent. Branchlets cylindric, woody, glabrous, brown. Leaves 8 - 13 x 2.5 - 5 cm, alternate, elliptic-oblong, abruptly acuminate at apex, entire along margin, cuneate at base, thinly chartaceous, dull green, glabrous, primary vein prominent, secondary veins obscure above; purplish green beneath, glabrous, primary and secondary veins prominent, secondary veins 6 - 10 pairs, weak brochidodromous, secondary vein spacing slightly decreasing towards base, secondary vein angle of origin more or less uniform, inter-secondary veins sometimes present, tertiary veins alternate percurrent, tertiary vein course sinuous; petiole slender, 6 - 10 mm long, glabrous, dark brown. Inflorescence of umbellules, 8 - 10 x 6 - 8 mm, male umbellules solitary, axillary, 4 - 5 flowered, female umbellules in racemes, 1.8 - 3.2 cm long, pedunculate, bracteate; peduncles 4 - 6 mm long, slender, pale green, glabrous; bracts 4, outer two 4 - 5 x 3.5 - 5 mm, concave, chartaceous, glabrous; inner two 3 - 5 x 3 - 5 mm, orbicular, membranous, glabrous; flowers 4 - 6 x 3 - 5 mm, yellow green; pedicel 0.5 - 0.8 mm long, puberulous; perianth lobes 6, c. 1.5 mm long, oblong, membranous, gland-dotted, green, glabrous; male flowers: stamens 12, in 4 rows, outer 2 rows 2 - 2.5 mm long, exerted, inner 2 rows c. 1.5 mm long, glandular; filaments glabrous; anther c. 1 mm long, 4 celled, introrse; glands c. 1 mm long, 2 each at base of inner rows of stamens, 2 lobed, sessile; pistillode c. 1 mm long, glabrous, rudimentary; female flowers: staminodes 12, in 4 rows, outer 2 rows 2 - 2.5 mm long, exerted, inner 2 rows 1.5 - 2 mm long, filaments hairy; glands c. 1 mm long, 2 each at base of inner rows of staminodes, stalked, 2 lobed; pistil 2.5 - 3 mm long, style 1 - 2 mm long, glabrous, stigma discoid, ovary c. 1 mm long, ovoid, glabrous; Berries 6 - 10 mm in diameter, globose, green when young, purple at maturity, glabrous, seated on persistent perianth, plate-like, 4 mm in diameter.

*Fl.*: June to December; *Fr.*: July to December.

*Habitat*: The species grows in evergreen and semi-evergreen forests from 700 m to 1400 m above the sea level in south Western Ghats.

*Distribution*: INDIA: Kerala, Tamil Nadu. Endemic.





Plate 1. A. Type of *Litsea beei* B. Type of *Tetranthera venulosa*

*Specimens Examined:* s.loc., *R. A. Beddome* s.n., acc. no. 45008, (MH); Kerala, Idukki district, Laxmi estate, 1300 m, 15-12-1982, *C. N. Mohanan* 76117, buds (MH); Puliyanmala, 1300 m, 15-12-1982, *C. N. Mohanan* 76124, buds (MH); Cardamom Hills, Mankulur below Munnar, 22-6-1976, *s.l.*, s.n., 226, acc. no. 128380, buds (MH); Tamil Nadu, Coimbatore district, Anamallays, s. date, s. coll., acc. no. 44700, buds (MH); Lower Nirar to Italiar forest, 950 m, 6-9-1983, *K. Ramamurty* 78449, fls (MH); Italiyar River Forest, 950 m, 8-9-1983, *K. Ramamurty & R. Chandrabose* 77507, buds (MH); Teni district, High Wavy Mountains, 4600 ft, 8-9-1925, *K. C. Jacob* 77072, buds (MH); Tirunelveli district, Courtallam Hills, 3000 ft, s.date, s.l., s.n., acc. no. 47874, female fls, (MH); Tinnevely Hills, 1854, *R. A. Beddome* s.n., acc. no. 44892, (MH); Tinnevely Hills, 1868, *R. A. Beddome* s.n., acc. no. 44698, (MH); Near Kannikatty, 800 m, 15-7-1964, *Henry & Chandrabose* 19876, fls (MH); Upper Inchikuzhi, Kannikatti, 750 m, 16-7-1964, *A. N. Henry & M. Chandrabose* 19911, male fls, (MH); Valayar Estate to Servalaru, 1000 m, 13-7-1976, *P. Bhargavan* 47470 buds (CAL, MH); Kannikatty R. F., 900 m, 18-7-1989, *R. Gopalan* 90590, male fls (MH); On way to Inchikuzhi from Kannikatti, 700 m, 24-10-1990, *R. Gopalan* 93328, frts (MH); Kanyakumari district, Kilaviarumalai, Balamore, 480 m, 28-7-1977, *A. N. Henry* 49428, male fls (MH). Agasthamala, 27.06.1994, *Rajkumar* 11760 (TBGT).

#### ACKNOWLEDGEMENTS

Authors are thankful to the Director, Botanical Survey of India, Kolkata, for facilities and encouragement and for the award of Flora of India Research Fellowship, to one of us (TB). The permission of the keepers to consult herbaria at CAL, MH and TBGT is gratefully acknowledged. The Indian Botanical Liason Officer, Kew has kindly provided digital image of the type collection from Kew.

## **CHIMONOCALAMUS LONGIUSCULUS HSUEH & T.P. YI (POACEAE: BAMBUSOIDEAE) A NEW RECORD FOR INDIA**

A.A. MAO AND M. BHAUMIK

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During Plant exploration tour to Apatani Plateau, Lower Subansiri district in Arunachal Pradesh in October 2008, an aromatic bamboo was collected by the first author. The plant sample was collected from the hills of 'Luro Poliang' near Ziro town, the head quarter of Lower Subansiri district. A clump of yellowish green bamboo with long internodes, was spotted, growing inside the subtropical forest at an altitude of c. 1715m. On approaching the bamboo clump, the local guide told that the bamboo's internodes contain clear water which is aromatic and nice for drinking. On cutting one of the bamboo culms, to the surprise it was found as told by the local guide. A single internode contains about 25 – 50 ml of the sweet aromatic liquid. It was also observed that the freshly cut and split bamboo when kept in room gives a strong sweet aroma for about a week. The plants appear to be rare as there were only a few clumps found in the whole hill during the survey. On close examination along with literature studies confirmed that the plant was reported as endemic to China (Dezhu & Stapleton 2006; Hsueh & Yi 1979). This is the first report from India and hence it is a new distributional record.

The description and illustrations of the plant is given here to enable easy identification of the bamboo.

**Chimonocalamus longiusculus** Hsueh & T.P. Yi Acta Bot. Yunnan. 1(2): 80. 1979.

Clump forming; each clump have 5 – 10 mature individuals. Culm 5 – 10 m tall, 1.5 – 2.2 cm diameter, thin walled, wall c. 4 mm thick, greenish, shining. Internodes 20 – 46 cm long, circumference of mature culm 7.5 – 8 cm, diameter 2 – 2.5 cm, smooth, containing liquids inside; nodes parallel, raised, sometimes asymmetrically raised, thorn 20 – 25 in each node, 0.5 – 2.3 cm long. Culmsheaths oblong, 19 – 22 x 6.5 – 8.2 cm, narrowed into rounded apex, yellowish, glabrous, shining, scattered brownish hairs towards apex, upper part margin brownish weavy. Culmsheath blade linear, 8.8 – 9.5 x 0.3 – 0.6 cm, brownish, narrowed in acuminate apex. Ligule rounded, 0.3 – 0.5 mm, membranous, truncate, hairy at apex and margin. Leaves narrowly lanceolate, 6 – 11 x 0.6 – 1.3 cm, finely acuminate, twisted at apex, gradually narrowed into petiole like bases, margin finely scabrous, primary nerves 3 – 5 pairs, cross veinlet distinct. Leaf sheath 2 – 2.5 mm long, nerves raised; leaf sheath auricle oblong, 2 – 5, c. 1 – 6 mm long, deciduous at maturity. Inflorescence not seen.

*Distribution:* Arunachal Pradesh: Luro Poliang near Zero, Subansiri; China.

*Local Name:* Tapiyu (Apatani).

*Specimen examined:* Luro Poliang near Zero, Subansiri, alt. 1715 – 1750m., 31.10.2008, A. A. Mao 19209(ARUN).

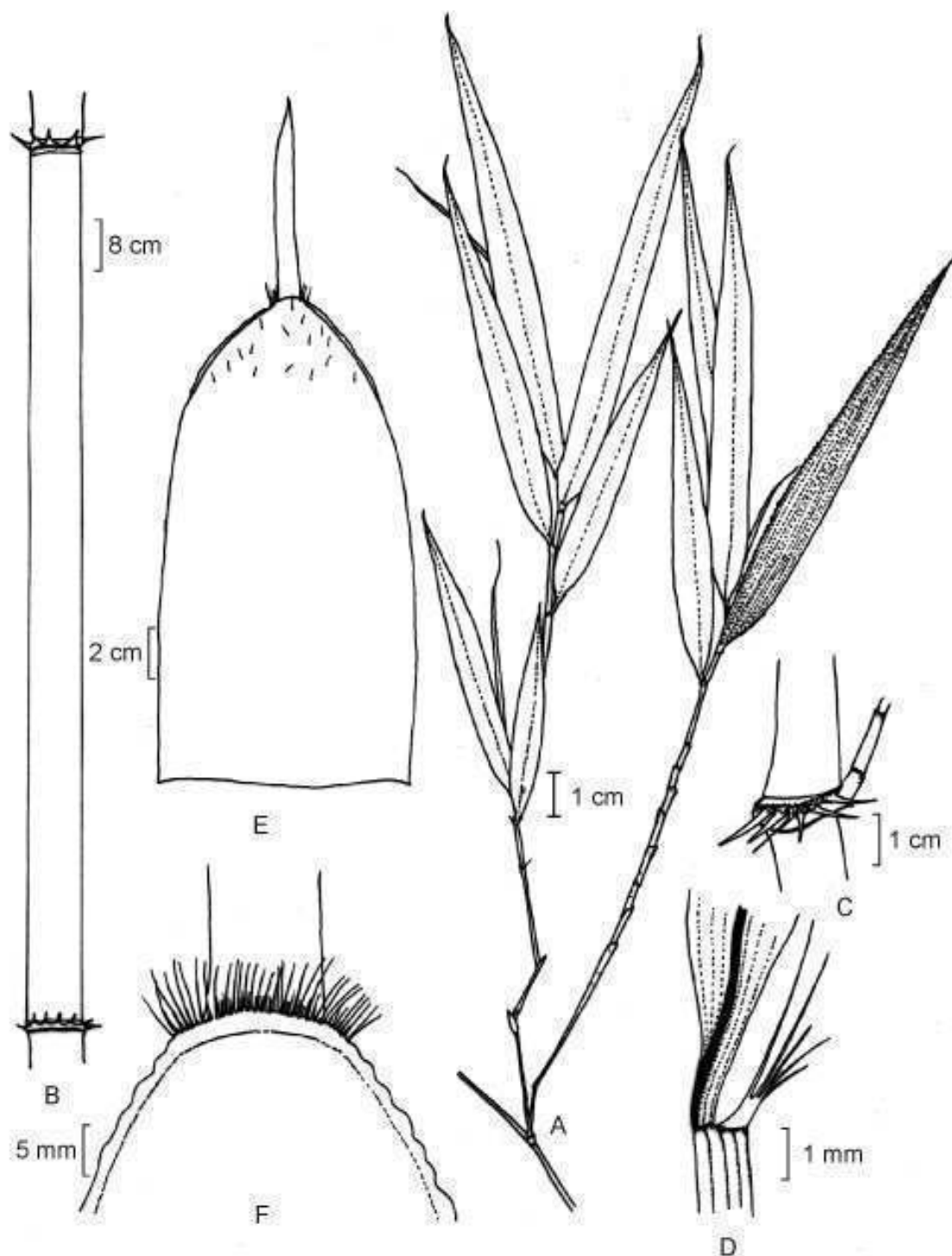
Note: About 11 species in the world distributed mainly in Eastern Himalayas, Myanmar and South West China (Mabberley 2008), 2 species viz. *Chimonocalamus griffithianus* (Munro) Hsueh & T.P. Yi and *Chimonocalamus longiusculus* Hsueh & T.P. Yi found in India. Most of the species under this genus are fragrant. This nodal thorny bamboo differentiated from its closest genus *Chimonobambusa* Makino by clump forming habit, thin walled and fragrant culms.

### ACKNOWLEDGEMENTS

Authors are grateful to the Director, Botanical Survey of India, Kolkata for providing necessary facilities.

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**Fig. 1.** *Chimonocalamus longiusculus* Hsueh & T.P. Yi. **A.** Leafy branch **B.** Culm showing internode **C.** Node with nodal thorn **D.** Leaf sheath auricle **E.** Culm sheath (dorsal side) **F.** Culm sheath (ventral side) showing ligule with hairs.

## A NEW SPECIES OF *LUISIA* GAUD. (ORCHIDACEAE) FROM ANDAMAN AND NICOBAR ISLANDS, INDIA

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*Luisia* Gaud. is one of the more difficult orchid genera in mainland Asia. As Seidenfaden (1971: 11) pointed out, this is due mainly to the “scarcity of a number of specific characters with little variation from species to species and considerable variation from specimen to specimen within the species”. It is mostly the relative size of the segments and the size and shape of the lip that have been used as distinguishing characters.

While making a reconnaissance survey of orchids in the Andaman Islands during February 2009, I discovered an interesting species of *Luisia* growing as a trunk epiphyte in tropical evergreen forest. The long stems are composed of a rather long, tough leafless proximal part and relatively short leafy apical part bearing medium-sized leaves. A couple of plants are in cultivation at the Regional Plant Resource Centre (RPRC), Bhubaneswar, where they flowered during the last week of August 2009. The flowers have a porrect lip with a rhomboid epichile and short, deeply concave hypochile lacking distinct side lobes. This form of hypochile is unique among the known species of south Asian *Luisia* from the Asiatic countries. It is therefore, described here as a new species.

***Luisia balakrishnani* S.Misra sp.nov.,** *labium floris unicom secus ovarium et pedicellum porrectum; labio-hypochilus parvissimus, profunde concavus et lateralio-lobi non distincti; epichilus planus, rhomboidus (in vulgo alium ovatum, cordatum, semilunatum vel oblongum); caulis elongatus; proximo-dimidium caulis longior, lignosum et apicalio-dimidium caulis frondosum.*

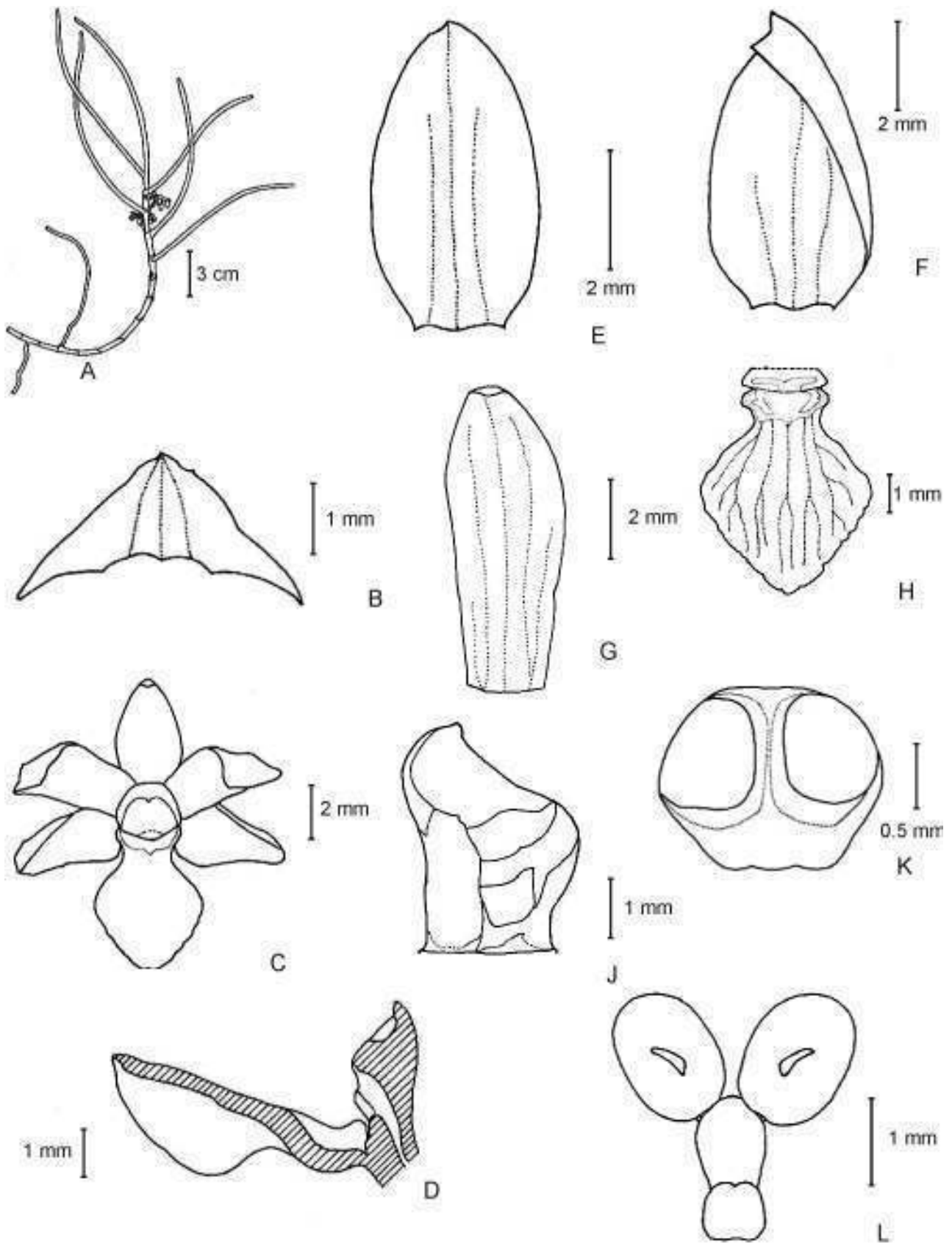
Holotypus: India. Andaman and Nicobar Islands: Andaman, near Jarwa on Andaman Trunk Road (ATR), on a roadside tree, S. Misra 2498 (CAL). (Fig. 1, Plate 1)

Epiphytic herb. Stems forming small tufts, elongate, slender, rigid; proximal length elongate, tough, 12–42 cm long, 3–4 mm thick, covered with leaf bases and remains of older inflorescences, distal half straight or slightly curved, 6–28 cm long. Roots 2–3 mm thick, vermiform, compressed. Leaves well-spaced, ascending, slightly curved inwards, terete, slender, apex narrowed, 9.5–13 × long, 0.2–0.35 cm. Inflorescence extra-axillary, appearing through the petiolar sheath below the leaf-base, erect, 12–16 mm long; peduncle minute; rachis 2 mm thick, 8–15-flowered, opening 2–3 at a time; floral bracts c. 4 × 2 mm, persistent, amplexicaul, minute, broadly triangular, acute, 3-veined. Flowers c. 10 mm across, pale purplish green, lamina of lip cream-coloured, sometimes with purple flushing, pressed flat against the pedicel-with-ovary, hypochile dark purple within, sometimes with a pair of sickle-shaped cream-coloured markings, column cream, sides deep purple. Pedicel-with-ovary 6–9 mm long, 1 mm thick, uncinat, pale green. Sepals and petals spreading. Sepals subequal 3-veined. Dorsal sepal c. 5 × 2.8 mm, elliptic, acute, slightly hooded. Lateral sepals c. 5.5 × 3 mm, concave, boat-shaped, dorsally keeled beyond the middle. Petals c. 7.5 × 2.8 mm oblong-obovate, obtuse, incurved at apices, 3-veined. Lip fixed immovably at the base of the column, porrect, fleshy, c. 5 × 4 mm; hypochile short, deeply concave, without distinct side lobes; epichile rhomboid, 5-veined, flat, margins slightly recurved, crenulate. Column c. 4 × 3 mm, straight, narrowed to apex; clinandrium cordate, concave; stigma squarish; rostellum short, with a truncate, upturned apex; anther c. 1.75 × 1.4 mm, front edge broad, truncate, indistinctly two-chambered, with a pair of obliquely ovate membranous flaps covering the pollinia; pollinia two, each c. 1.5 × 1.1 mm, yellow, firm, oblong in outline, apices rounded, obliquely, deeply perforate; stipes c. 1.1 × 0.8 mm, broadly spatulate, hyaline; viscidium c. 0.7 × 0.7 mm, squarish, front edge retuse, pale brown.

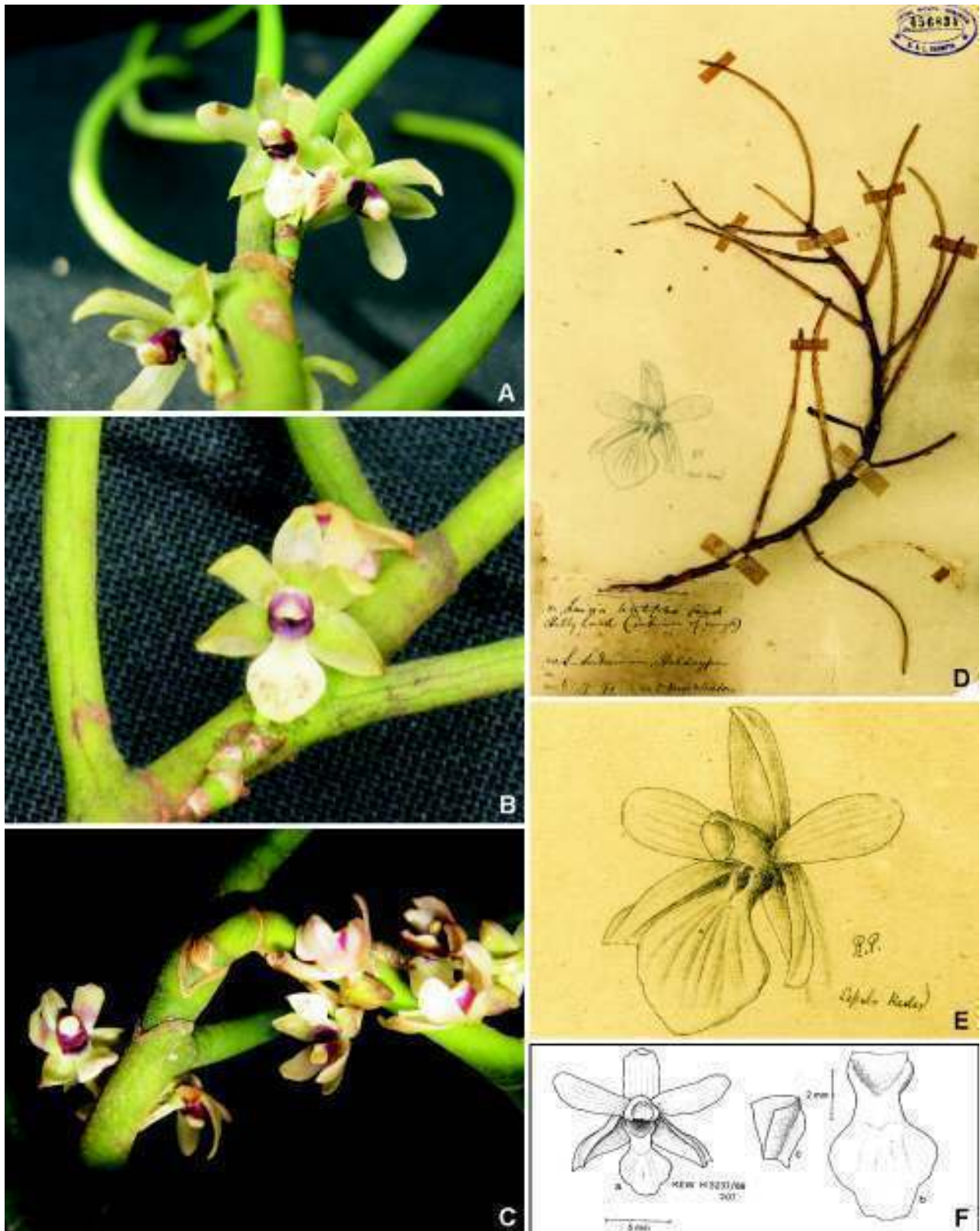
*Habitat and Ecology* : Tropical evergreen forest, growing in the open low down on tree trunks; c. sea-level.

*Flowering* : Late August to October.





**Fig. 1.** *Luisia balakrishnanii* S. Misra. **A**, habit; **B**, floral bract; **C**, flower; **D**, longitudinal section through column and lip; **E**, dorsal sepal; **F**, lateral sepal; **G**, petal; **H**, lip; **J**, column; **K**, anther-cap, **L**, pollinarium (**A–C** and **D–L** from *S. Misra* 2498; **D** from *S. Misra* 2499. Drawn by S. Misra.



**Plate 1.** *Luisia balakrishnanii* A & B, flowers of Jarwa plant; C, flowers of Dhanikhari plant; D, image of herbarium CAL accession no. 456834; E, image of sketch of flower from the above, drawn by Robert Pantling; F, copy of fig. 44 a-c, after Seidenfaden (1971).

*Occurrence*: Dhanikhari arboretum of the Experimental Garden of the Botanical Survey of India, S. Misra 2499 (paratype); in cultivation at RPRC. South Andaman, *King's Collector sine no.*, (CAL acc. nos. 456834; 456835 ! paratypes CAL); Andaman Islands, *sine loc.*, *Sanders, sine no.* Kew acc no. K 000364997 (K paratype).

*Etymology* : This species is named after Dr N.P. Balakrishnan, formerly of the Botanical Survey of India, for his immense contribution to floristic study in India.

*Notes* : *Luisia balakrishnanii* has a unique lip that is pressed flat against the pedicel-with-ovary. The hypochile is much smaller, concave and lacks distinct side lobes. The epichile is flat, rhomboid, rather than being ovate, cordate, semi-lunate or oblong as in most other species. The elongate stem has a longer, tough proximal portion and leafy distal portion.

There are a couple of specimens in CAL from the south Andamans collected by George King on 6 September 1890, labelled as *Luisia teretifolia* (the specific epithet having later been crossed out). On one sheet (CAL acc no. 456834) Robert Pantling has drawn an excellent sketch of the flower, the lip exactly matching *L. balakrishnanii*.

Seidenfaden (1971), in his revision of mainland Asian *Luisia* Gaud., excluded some plants which he was not able to identify, remarking "further finds may prove that they are new species, but for the time being I hesitate in establishing as such". One of the above, originating from the Andaman Islands and located in the Kew herbarium, was labelled *Luisia andamanensis* but never published. It was cultivated at Glasnevin Botanic Gardens, Eire, who received it via Messrs. Sanders & Son. Seidenfaden (1971: 89–90) provided a sketch of the flower of this plant (Fig. 44 a–c) and observed that "the lip has a peculiar hypochile with deep nearly triangular fovea at its base, surrounded by fat ridges". The lip of *L. balakrishnanii* matches this sketch. I have seen an image of these specimens, very kindly sent to me by staff at Kew herbarium. This is a single herbarium sheet bearing the accession number K000364997 and containing two specimens, each with one loose leaf and an inflorescence. Each inflorescence consists of four flowers, about 10 mm across. On the sheet Seidenfaden has written a note dated November 1970 "I believe this to be a *nomen nudum*. But also I believe it to be a new species, I cannot place it".

From study of living material and the herbarium specimens at CAL and K cited above, I support the views of Seidenfaden in treating this entity as a new species.

#### ACKNOWLEDGEMENTS

I am grateful to Dr M. Sanjappa, Director, Botanical Survey of India (BSI) and Dr S. Kumar, Additional Director, Andaman and Nicobar Circle, BSI for help with studies in the field; the curator, Central National Herbarium, BSI for permission to consult the herbarium; to Dr V.J. Nair, Coordinator, All India Coordinated Project on Taxonomy (Grasses and Bamboos), BSI, Southern Circle, Coimbatore, for providing the Latin diagnosis. My grateful thanks are due to the Ministry of Environment and Forests, Government of India for support under the AICOPTAX programme. I also would like to thank the Chief Executive, RPRC for providing institutional support; Sri P.K. Nayak and S.P. Panda, Research Fellows, for help in cultivation of the plants brought from Andaman; to Renata Borosova and Jeffrey Wood of the Kew Orchid Herbarium for very kindly sending an image of the herbarium sheet at my request.

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## BOOK REVIEW

**Bamboos at TBGRI** by K.C. Koshy. Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram-695562, Kerala, India. 2010. pp. 104. Paperback edition. ISBN: 978-81-920098-0-3, Price: ₹ 800, US \$ 30.

The monumental and comprehensive work of J.S. Gamble forms the baseline for advancement of Bamboo studies in India. Even after the lapse of over a hundred years, this work is extensively used in India and South East Asia, not only by taxonomists and foresters but also by other specialists in morphology, biochemistry, molecular biology, anatomy and palynology.

The first post-independence exploratory work on bamboos in India, was initiated at Forest Research Institute, Dehradun and Botanical Survey of India at Kolkata and Shillong. Subsequently, several reports, research papers, catalogues and detailed taxonomic accounts on the grasses and bamboos from various parts of India have been published. Most of these publications give purely technical descriptions used by well trained taxonomists and usually lack good illustrations and colour photographs to aid field identification. Therefore, these books could not attract the attention of the general public, nature lovers and nurserymen towards bamboos. More recently, illustrated books on bamboos have been published for India (by Seethalakshmi & Kumar, Tiwari) and Assam (by Baruah & Borthakur). It is pertinent to note that during the last 50 years, the nomenclature of Indian bamboos has undergone major changes due to revisionary works and monographic studies throughout the world particularly in China and Malesia. However, there is no general agreement about the generic concept and identity of several species complexes in India. Only study of live material can help in untangling so many identity problems that Indian bamboos face. Botanic Gardens and Bambusetums can contribute in significant way in our understanding of bamboos.

The book under review- *Bamboos at TBGRI* by K.C. Koshy is a step in this direction and is very useful and informative book about the different species growing in the Bambusetum at TBGRI which are introduced from different regions of India and other countries, accounting for a large collection of live specimens of this unique group of plants.

The book containing 104 pages has been divided into three chapters. Chapter one deals with the establishment of the Bambusetum at TBGRI which explains the initiative taken by the author and the cooperation extended by different authorities & personalities for establishing the Bambusetum. Practical difficulties encountered in establishing this bambusetum and particularly excavation and transport of bulky rhizomes and propagules from Manipur and Arunachal Pradesh have been well presented by the author.

In the second Chapter of the book, Bamboo resources at TBGRI are dealt under four categories – Live collections, Herbarium & Spirit collections, Museum specimens and Bamboo nursery. A detailed account of 68 species, 12 new hybrids and one variety under 15 genera is arranged alphabetically. It seems to be the largest collection of bamboos in any bambusetum in India. Each species is provided with correct name, synonyms, reference to major works, short description and distribution. The most important part of this chapter is information about the live accessions and different hereditary lines of each species raised and maintained in the Bambusetum and their exact location (which have been indicated on the Map) with planting date and province. This in addition is supplemented with the voucher number of dried specimens and spirit collections, thereby giving complete information about all the representing specimens of each species present at TBGRI.

Chapter three deals with the prospects of the bamboo cultivation for sustainable utilization and hybrid production for quality improvement.

The photographs provided for the species are excellent and helpful in identification of species but it would have been more useful if photographs of diagnostic characters and range of variation in different morphological parts were also given for their correct identification. Overall the author has presented the subject in a comprehensive way, though the book is lacking the identification key to the species, but author needs to be congratulated for developing one of the best bambusetums of modern times in this part of the world. It also clearly reflects how little we know about the bamboos and how difficult it is to identify this enigmatic group as there are 17 species in the book under *Bambusa*, *Dendrocalamus* and *Ochlandra* which are yet to be identified.

The book has been aesthetically designed and well printed and is a must for all bamboo lovers, though the price appears to be on the higher side.



PARAMJIT SINGH  
Botanical Survey of India  
Kolkata

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Nelumbo is a journal primarily meant to publish results of taxonomic research. It is open to researchers in India and abroad working in plant taxonomy, biosystematics, ethno- and economic botany, phytogeography, endemism and studies related to recognition and conservation of IUCN red-listed plant categories. Original articles, critical reviews and short communications are usually considered for publication. Mere compilations of published materials missing analysis, scientific argument and worthwhile conclusions are summarily rejected.

Manuscripts, neatly computer typed in double space with adequate margin on a good quality A4 paper with pagination indicated on upper right hand corner, should be submitted in duplicate. Illustrations in original and photographs on a glossy paper, not smaller than 15 × 9 cm, should be submitted. Illustrations and photographs should be numbered by Arabic numerals. Acknowledgements should be precise and should be at the end but prior to references cited. An abstract (c. 150 words) in English and Hindi should be included for all papers and reviews but not for short communications. In addition, the authors must send soft copy of the manuscript on a CD in MS Word or PageMaker. We encourage the submission of manuscripts by email to **bulletinbsi@gmail.com**. In papers on floristic enumeration, the correct names of plants with authority should be given. Specimens cited in the text are to be deposited in one of the BSI Herbaria or in any other recognized herbarium (in case of other institutions) and this is to be clearly specified through acronyms.

New reports and new records for India and for different phytogeographical regions of the country should include notes on habit, habitat and associated plants. It is desired that several new records together, and not one or two, appear in a paper. In case of new taxa, holotypes or isotypes are to be deposited at the Central National Herbarium (CAL).

Monographs and revisions on specific taxon/taxa, the authors should give details in the order specified below in the citation of concerned taxon: (1) the correct name with its authority and citation (2) in case of a combination the basionym with its citation and (3) synonymy in chronological order. Only bracketed keys are to be employed while keying out the species.

Standard book/flora abbreviations (Taxonomic Literature, ed. 2, Stafleu & Cowan, 1976-1988 & its Supplements 1 – 6 by Stafleu & Mennega, 1992-2000) standard journal/periodical abbreviations (Botanico-Periodicum-Huntianum, Lawrence & al, 1968; Bridson & Smith, 1991 & Botanico-Periodicum-Huntianum, ed. 2, 2004) and standard author abbreviations (Authors of Plant Names, Brummit & Powell, 1992) are to be followed and with consistency.

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For quoting original works

GAMBLE, J.S. 1915 – 1936. Flora of the Presidency of Madras. 11 Parts. Adlard & Son Ltd., London.

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